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Reclamation of Bog Land in Norway

VOLUME 5, No. 8 AUGUST 1953

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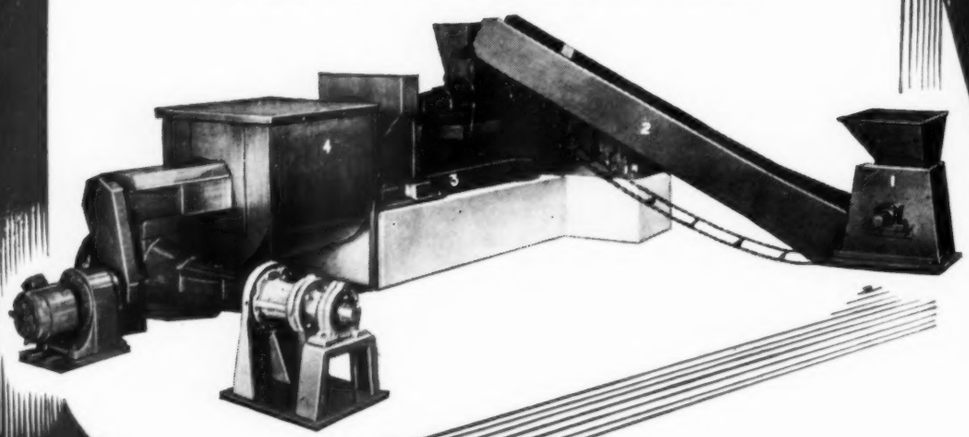

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Vol. 5 No. 8 AUGUST 1953

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Reclamation of Bog Land in Norway

The cover picture shows a Howard Rotavator and Ferguson tractor reclaiming part of a 12,500 acre Bog owned by the Agricultural Advisor of the Norwegian Society for the Reclamation of Bog Land. About two-thirds of this Bog is covered with a dense growth of dwarf birch, heather and moss, and it has been found that the best implement to deal with this is the Rotavator.

Rotary Hoes Ltd., Horndon, Essex, England

Announcement

EDWARD CURRAN ENGINEERING LTD. are pleased to announce that arrangements have been made with IMPERIAL CHEMICAL INDUSTRIES LIMITED for the manufacture and marketing of the I.C.I. DRYER FOR GRASS AND GRAIN. This will be known in the future as the CURRAN MARK III FARM DRYER.

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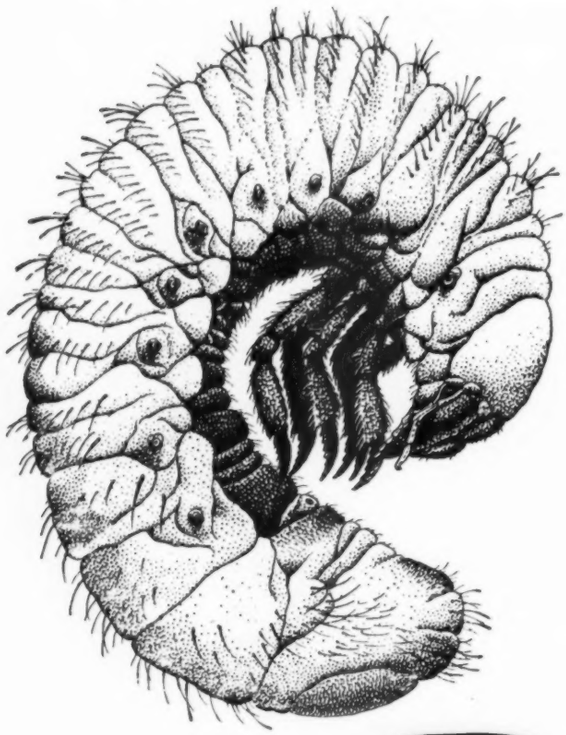
White Grub (*Phyllophaga and Melolontha spp.*)



NEW fighting weapons for agriculture

The majority of agricultural pests are doomed, now that two new Shell insecticides, *aldrin* and *dieldrin*, have entered the battle to grow more food.

Of these new pest destroyers, *aldrin* is the one to use against white grubs. Dust *aldrin* over the soil before sowing cereals, root crops including potatoes, or grasses; or spray the soil with *aldrin* during cultivation.

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Editorial Comment

Food and the future

THE series of lectures and discussions under the above intriguing title organised in London by the Food Group of the British Society of Chemical Industry has now reached its conclusion. At the final session of the series in April last a paper was read by Dr. W. F. J. Cuthbertson with the title of ' Synthetic Possibilities,' and the conclusions to be reached on the results of the whole series of papers were summarised by the chairman, Dr. N. Wright.

Certain writers of so-called scientific fiction have in the past toyed with the idea of a future condition of the human race when the bulk of the food required would be produced by the efforts of the synthetic chemist in replacement of the labours of the agriculturist; the idea has superficial attractions, particularly in view of rapidly increasing world populations and diminishing resources of available agricultural land. In his lecture, Dr. Cuthbertson was somewhat discouraging on the outlook for such dramatic developments, and while agreeing that we may be on the verge of a further agricultural revolution by the conjoined application of mechanical power and chemistry to the land, he pointed out that the bulk synthesis of food from raw materials of mineral origin is unlikely to offer a permanent contribution to human nutrition. Coal and oil appear to be the most promising raw materials, but these are wasting assets and if they are called upon to serve as raw materials for food, in addition to their expanding present consumption, their rate of use is bound to be accelerated and the time of their ultimate exhaustion brought appreciably nearer. Even though atomic energy may offer a new source of power, its use could only postpone the ultimate exhaustion of supplies of fossil carbon compounds suitable for transformation into food.

Carbon dioxide will, of course, always be available, but the demands in the way of power and plant needed to produce food from carbon dioxide and mineral matter would, so far as can be foreseen, be so great as to make impracticable any synthetic process based upon it.

It would seem, therefore, that the world is likely to remain dependent on biological processes for its supplies of food for any forseeable period ahead, and in particular on the use through biological channels of sunlight and carbon dioxide. On the other hand, the chemical transformation of waste materials from agriculture, which are at present unutilised but are capable of transformation into foods, could lead to the production of vastly increased quantities of food.

A further important chemical contribution is the increasing synthesis of raw materials needed by plants and animals for the production of food. The oldest and best known example is the synthesis of nitrogenous fertilisers from atmospheric nitrogen, but there are many others, for example the synthetic production of insecticides, fungicides and weed killers which may be considered to enter this category inasmuch as by their use large quantities of foodstuffs, both in the field and in store, may be protected from destruction and made available. Moreover, the synthetic production of vitamins and other essential supplements is another important direction in which chemistry is aiding food production.

While, therefore, the direct synthetic production of vast quantities of foods may be a dream that is unlikely to be realised, the indirect effect of chemical synthetic processes and products on food production is already considerable and is likely to become increasingly important as time goes by.

Some conclusions

IN summarising the outcome of this series of discussions, Dr. Nigel Wright distinguished between conventional and unconventional methods of increasing food supplies, and concluded that apart from the possibilities of using leaf protein directly as food (see in this connection the article on protein production by N. W. Pirie in WORLD CROPS, 4, 174), the outlook for unconventional methods is discouraging; the experience with food yeasts has been disappointing, the possibility of producing synthetic fats can not be regarded as very hopeful, while the synthesis of bulk food seems very unlikely especially having regard to the energy requirement. It was possible that recourse to the large-scale production of the green alga *Chlorella* as a source of food (see WORLD CROPS, 4, 250) might eventually be necessary if populations continued to increase at their present alarming rate, but the cost of this in terms of human activity could not be ignored. Even if such projects succeeded the problem would remain of converting structureless and insipid material into acceptable foods.

In the circumstances, the conclusion cannot be avoided that developments in the future are almost certainly bound to be along conventional lines, aided and reinforced by recourse to the methods which the scientist, and in particular the chemist, can provide, rather than by eclectic and startling developments based upon new and unconventional procedures. As Dr. Wright said, ' Science alone cannot provide the answer to the problem of food and the future; it can help, but man himself must decide what use is made of science. Bold and imaginative leadership is called for, combined with intelligent application of the scientific results by the agricultural population of the world.'

News of Krilium

SINCE the Monsanto Company called attention to the soil conditioner which they were responsible for placing on the market under the name of Krilium, agricultural experiment stations in many parts of the world have been engaged in experiments to test the efficiency and the economic possibilities inherent in the use of this and the other soil conditioners now appearing in increasing numbers.

Among the latest results recorded are those of a series of experiments carried out at the Illinois Agricultural Experi-

ment Station where Messrs. H. P. Bateman and G. E. Packard report that when soil in the station was treated with Krilium, draft on the plough was reduced by 25% and there was also a considerable saving of time and power in the preparation of a seed bed, while on plots treated with Krilium and seeded to maize the improved physical condition of the soil favoured better root development and there was also less lodging on the plots that had received treatment with the soil conditioner.

Experiments at the United States tobacco laboratory at Lancaster, Pennsylvania, to test the effects of Krilium on lands planted with tobacco, are also reported to have given encouraging results; thus plots treated with Krilium but without commercial fertiliser are stated to have given an increase of 71 lb. of leaf per acre as compared with adjacent plots which received no Krilium and no fertiliser.

On the other hand, when Krilium was applied to plots carrying tobacco, in conjunction with potash fertiliser conveying 120 lb. of potash per acre, an increased yield of 223 lb. of leaf per acre was recorded as compared with similar plots which received a similar dressing of potash fertiliser but no Krilium. In all cases the Krilium increased the average root weight of the tobacco plants; Krilium without potash increasing the individual root weight by over 1 oz., while Krilium with potash at the rate of 120 lb. per acre increased the root weight by 3 oz.

It should, however, be added that Messrs. Bateman and Pickard have pointed out that while some soil conditioners can do a good job in improving soil structure or tilth when they are properly prepared and properly applied, they are still far too expensive for general use on farm fields. The rates of application used in the experiments at the Michigan Agricultural Station ranged from ¼ ton to 3 tons per acre.

It would appear, therefore, that the possibility of using soil conditioners of this type on agricultural land depends on the ability of the manufacturers to place the product on the market at prices considerably lower than those which at present obtain. This, however, may not preclude their economic use in horticultural practice, *e.g.*, in greenhouse work where the financial returns per unit area are considerably higher than in ordinary arable farming.

Mate—A rival to tea and coffee?

RECENTLY, the Brazilian Government has renewed its efforts to direct attention to the export possibilities of mate a product made from the leaves of *Ilex paraguayensis* which has attained wide popularity in South American countries, but is little known in other parts of the world. It is the national drink of many countries in the South American region and is prepared by infusing the dried leaves of the plant in boiling water with milk and sugar or with lemon in the same way as ordinary tea. Made in this way it is claimed that it provides a pleasant and refreshing beverage.

Its use in South America dates back to Inca or pre-Inca times and was observed by Spanish Jesuits, in Paraguay in the 16th century, who are alleged to have noted with amazement the effects which the plant had on the native Indians of this region. Apparently, the leaves exercise a remarkably stimulative and restorative effect on those who consume the product, enabling them to sustain long periods of strenuous toil without undue fatigue.

Ilex paraguayensis is in its natural state an evergreen medium-sized tree, related botanically to the common holly. It occurs naturally throughout the temperate zone of South America and is also reported to be cultivated in bush form like ordinary tea. Most of the supplies of commerce, however, are derived from wild stock. Apart from its attractions as a beverage, it is believed to have marked medicinal properties. It is a powerful diuretic and is alleged to be a solvent for uric acid and to have a specially strong influence in rheumatic disorders; indeed, it is claimed that in those parts of South America where mate is widely drunk rheumatism is unknown.

The average annual production of mate is stated to be about 80,000 tons. The manufacturing process is simple and consists of drying the leaves in some form of oven and afterwards grinding them to powder. Consumption is at present largely confined to South America, although there is a small export trade mainly for the benefit of former residents of the South American region who have acquired a taste for the beverage, or for rheumatic sufferers who believe in its virtues. There is a Mate Institute in Brazil, the object of which is to expand and popularise the consumption of the product. Under its influence, some scientific work has been done on the physiological action of mate and this apparently confirms the claims made for it. If further experimental investigations in other countries bear them out there seems to be some reason to think that mate may have a future as an export product, thus adding one more to the impressive list of crop plants which the world owes to the South American region.

Agricultural crisis in Greece

FARMERS all over Greece are reported to be looking at their ill-equipped acres and wondering how long American aid is going to last under the Eisenhower administration. The reason is an abrupt decision by an American mission in Greece to suspend the loans which have enabled farmers to buy tractors and other machinery on credit. News of the decision is reported to have caused general consternation, while the damaging effects of the mission's action are only too evident.

In support of their decision, the mission is reported to have said that there are already too many tractors and implements in Greece, that those already there are only partially used, while mechanisation would cause unemployment, and that farmers are not in a position to pay their loans. These are the views of the mission's financial experts. Those of the members of the Food and Agriculture Organisation were apparently overruled.

It is believed that today there are fewer than 6,000 tractors in the whole of Greece—one tractor to every 1,500 acres of cultivated land. (In Britain there is one tractor to every 55 acres.) The argument of the American mission that this is too many seems contrary to all expert opinion. The United Nations Economic Commission for Europe, for example, reported last year that the tractors needed by

Greece by 1956 amounted to 20,000 machines. It would be tragic if support and encouragement were taken away from the many individuals and private organisations that are helping Greece to fight her domestic problems.

America has insisted on Greece maintaining an army of ten divisions for defence against possible Communist aggression, but despite a great deal of assistance many people driven from their homes in the guerilla war of 1945-46 are still reported to have practically no means of subsistence and last winter lived mostly on vegetables and roots; they had no animals or tools to help them with the cultivation of the soil. They are, in fact, an easy prey to the false promises of Communism.

The first essential is to enable the people of Greece to make intelligent use of the resources at their command. More timely cultivations, the use of fertilisers, better varieties of seeds, and the reclamation of waste land are all aids to progress, but they cannot result in more food unless machinery is available. A great deal has already been done as shown by articles which have appeared in WORLD CROPS from time to time. For example, between 1950 and 1951 the number of tractors on farms increased to 5,184 from an originally very low figure, while the number of people employed in agriculture rose by 7%. It is clear that much of the progress on record has been the result of the application of American aid, and it appears that the action of the American mission may be short sighted. Greece is a purely agricultural country and it is only by modernising her agriculture and making it more productive that the advances of Communism can be successfully stayed.

International Sugar Conference

THE news that the Secretary-General of the United Nations has agreed at the request of the International Sugar Council to call an international conference on sugar supplies in London in July of this year has aroused widespread interest and attention. It is hardly surprising that this should be so, inasmuch as it has been widely felt for some time past that the international situation in regard to sugar supplies was decidedly disturbing, and that on an orderly solution of the potentially alarming supply problem much depends.

It may be recalled that world supplies of sugar, both cane and beet, have of late years increased enormously. Prior to the last war, the total world production of sugar amounted to approximately 29 million tons. During the war and in the years immediately succeeding it fell considerably, but by 1948 things had become sufficiently restored that production commenced once more to exceed the pre-war figure, amounting in that year to over 30 million tons. Since then production has advanced rapidly and by 1951-52 exceeded 37 million tons, an advance of over 8 million tons on the pre-war figure. Despite population increase, it seems obvious that such an increase in a short period must greatly stretch the ability of the world to consume it.

As usual with sugar the situation has been complicated and obscured by various regional and international agreements and arrangements; the British Commonwealth sugar agreement, concluded this year, is an example of these and the more recent decision of the U.K. Government to purchase 1 million tons of Cuban sugar is another. There seems indeed to be some fear in certain quarters that if such a conference as that proposed is held it may produce circumstances inimical to the Commonwealth agreement, which is the basis for much long-term planning in all the signatory countries; but the U.K. Government has pointed out that the Commonwealth agreement in any case commits signatories to it not to become parties to any other international agreement which runs contrary to the provisions of the Commonwealth agreement.

It is curious that over-production of sugar was a feature of conditions after the first war and that these were not resolved until the signature of the international agreement in 1937. It is certainly fortunate that the machinery for implementing this has been kept in existence, although the agreement itself has been in abeyance during and since the war; should the projected conference result in a revival of the former international control scheme, the need should not arise of creating machinery for its implementation.

It is a coincidence that the present conference should coincide with the coronation of H.M. Queen Elizabeth II, since the earlier international conference which led to the signing of the international agreement was held almost simultaneously with the coronation of her father, King George VI. Let us hope it may have equally favourable results, and that, incidentally, it will enable the British Government to end the anomaly of sugar rationing in Britain in the presence of a world production of sugar which far exceeds any previous records. Such an event is, in fact, already provisionally promised and it is only the intricate mass of administrative commitments which has prevented it materialising earlier.

The annual review of British farming

THE British Ministry of Agriculture has recently issued its annual review of the economic conditions and prospects of British agricultural industry in the form of a white paper (Cmd. 8798). It is reported that the new food production drive has got off to a good start and production for the past year (1952-53) was estimated to have amounted to 51% of pre-war. The official hope that as a result of last year's awards the way would be cleared for a substantial increase in the home production of food appears to be in a fair way to being realised. There have been substantial increases in the production and use of grass, and of the tillage area. The numbers of livestock have increased also, as has the output of livestock products. There seems to be every hope that the long-term target of an increase of the output to 60% over pre-war by 1956 may be achieved.

Extra replacement costs which farmers have had to bear during the past twelve months have been considerably less than in the immediately preceding years; they were in fact estimated at £40 million in 1951-52 and only £17 million in 1952-53. This decline should help farmers to increase food production and is evidence of the success of the Government's general agricultural policy for checking rising

costs. It is but reasonable that the agricultural producer should share with the consumer and the taxpayer the results of the continuing increase in productivity, but in view of the fact that in the early stages of the production drive farmers need additional capital, the Government have decided that agricultural industry should for the present retain a larger share of the benefits from increased efficiency than might be justified in other circumstances.

The estimated increase in costs over a full year amounts to nearly £26½ million, which includes the effects of ending the subsidy on feeding stuffs which took place in March, 1953. Cereals and eggs are shortly to be decontrolled and this necessitated the reconsideration of the review commodities in two groups, *viz.*, those of which the prices remain fixed and those which have been decontrolled. For fixed price commodities the Government have awarded increases amounting in all to £11½ million with a further addition to the marginal production schemes of £4 million, making the total recoupment on fixed price commodities of £15½ million against a cost increase of £17 million. In regard to marketing of cereals, there have already been preliminary discussions about future marketing arrangements; they hope these may be concluded in time for the 1954 cereal harvest. Meantime, they propose no change in the prices for cereal crops.

Most people will agree that the Government are making reasonably good progress with the difficult task of reducing subsidies to agricultural production and, so far as may be wise, freeing commodities from controls. It is realised that the frequent changes which were so prominent a feature of their predecessors in office are unsettling and should be avoided so far as possible, and all will wish the Government well in their efforts to increase agricultural production and to improve the position of the farmers without imposing undue burdens on the general community.

World fertiliser production and consumption

THE Agriculture Division of FAO has lately produced a valuable survey of the present position in regard to the production and consumption of fertilisers. It appears that both are steadily increasing in almost all parts of the world. This is, of course, in response to growing demands for food and raw material and is evidence of the growth of appreciation and knowledge of the effects of fertilisers in increasing yields. Equally important is the increase in knowledge of the correct use of fertilisers, the time to apply them and the kinds and quantities to use.

In so far as concerns the various nutrient elements, nitrogen shows by far the greatest increase in production and consumption. It is a significant fact that for the first time in history synthetic nitrogenous fertilisers are now being manufactured in every continent in the world. In 1951-52, for example, the total production of nitrogen in fertilisers amounted to 4,380,000 tons, an increase of 9.2% compared with the previous year. The largest percentage increase was in Asia where it amounted to 18.6%, this being mainly due to the coming into operation of the new plant at Sindri in India which produces sulphate of ammonia and to increased production of various kinds of synthetic nitrogenous fertilisers in Japan. Another important contributory factor was the production for the first time of synthetic nitrogenous fertiliser in Egypt, the outturn amounting to 180,000 tons of calcium nitrate, equivalent to 27,000 tons of nitrogen. Previously, fertiliser nitrogen was not produced in Africa although ammonium nitrate was manufactured in South Africa, but is not believed to have been used for fertiliser purposes.

Phosphoric acid production, on the other hand, shows only a comparatively small increase amounting to 145,000 metric tons, or 3.0% on the previous year's outturn of 5,770,000 tons. Superphosphate production declined in the United States and many European countries, including the United Kingdom and Holland, also in India; elsewhere it increased slightly. Potash production increased also, the percentage amount being 3.6%, slightly greater than for phosphoric acid.

The growth of consumption has been sufficient to ensure that the whole of the available supplies of fertilisers of all kinds have been absorbed. The outlook is that in the coming years production and consumption will continue to expand. Nitrogen production and consumption for the next yearly period is expected to increase by about the same amount as in the previous year; phosphoric acid is expected to expand by a somewhat larger amount, while potash is expected to show a considerable increase owing to the opening up of new sources of supply in the U.S.A. and Europe. Some anxiety is felt about anticipated supplies of phosphorus in view of the considerable prospective increases in nitrogen and potash production, since it is important that they should be adequate to enable the larger tonnages of nitrogen and potash to be used to advantage.

It is obvious that the world wants and plans to use more fertilisers; whether this desire can be met depends on available supplies and, above all, on the price at which they can be made available as well as on world prices for agricultural produce.

The recession which the world is at present witnessing in prices for many classes of agricultural produce other than food can considerably influence the position for, even under present-day conditions, the use of fertilisers to increase yields is only economic when the value of the increment of yield obtained from the application exceeds the cost of the fertiliser applied.

The Royal Show

THE Royal Show, which was held from July 7 to 10 on a 136-acre site in Blackpool, was once again an outstanding success, the paid attendance on the four days amounting to no less than 118,291, over 25 per cent more than the total attendance at Newton Abbot last year. We hope to include a report of the Show in our September issue.

The Damodar Valley Project

S. RAMANATH

The Damodar Valley project represents the greatest effort so far made by the Government of India to improve production by developing and utilising undeveloped river resources. Based upon the Tennessee Valley project in the United States the Damodar River Valley project aims at regulating the flow of a river which previously has been noted for flood damage and erosion, and developing its resources for power production, irrigation and transport.

AMONG the activities launched by the Government of India, the Damodar Valley Project—controlled by Damodar Valley Corporation—occupies a prominent place. The Damodar River, long noted for its frequent destructive floods, is now being tamed. The present multi-purpose scheme, which is based on the model of the Tennessee Valley scheme in the U.S.A. (WORLD CROPS, 2, p. 51), was designed not only to affect flood control but also to develop irrigation, power and navigation. Other objectives of D.V.C. are water supply, afforestation, the control of erosion, the promotion of public health, and to promote agricultural, industrial, economic and general development and well-being in the valley. The Damodar Valley Corporation Act, 1948, provided wide powers to the corporation, which is modelled on the general lines of the Tennessee Valley Authority. The aims of the project are to construct:

(1) Eight dams on the Damodar and its tributaries and hydro-electric stations with a total capacity of 240,000 kw.; the total reservoir capacity of the dams would be 4.7 million acre-feet and they would protect the valley from a flood of 1 million cusecs or less.

(2) A thermal power station utilising low-grade coal, of 200,000 kw. installed capacity, to even out the seasonal fluctuations of hydro-electric power and to provide, in combination with the hydro-electric system, firm power of 300,000 kw. capacity at 60% load factor.

(3) A power transmission grid covering 470 miles of 132 kw. primary lines.

(4) A barrage at Durgapur (which is 27 miles below Asansol) and a 90-mile long irrigation-cum-navigation canal joining the River Hooghly 30 miles above Calcutta, with a system of distributaries 1,553 miles in length.

Four dams are to be constructed in the first phase of the project which would protect the lower valley against the highest flood hitherto recorded. With the opening of the Tilaiya Dam and the Bokaro Thermal Power Station, two of the major projects included in the first phase programme have been completed. Of the remaining dams, Konar is expected to be finished before the next monsoon, Maithon a year later and Panchet Hill by 1955, when the irrigation barrage at Durgapur and the network of canals and distributaries will also be ready. During the monsoon the rainwater will be stored in the reservoirs formed by the dams and the water will be regulated for producing hydro-electric power, irrigating over 1 million acres of land and facilitating navigation to and from Calcutta.

Soil erosion of the land at Hazaribagh (Damodar Valley) before reclamation

The Tilaiya Project

This all-concrete dam was completed in September, 1952; with it are associated two 2,000 kw. hydro-electric generators, the first of which was switched on by the Prime Minister of India on February 21, 1953. The water released from the 26-square mile reservoir so created will provide Rabi irrigation for 75,000 acres and Kharif irrigation for 24,000 acres, totalling 99,000 acres a year. The hydro-electric output has been computed at 22,770,000 kw. hours per annum. The dam will also contribute to the moderation of floods in the lower valley. The hydro-electric station will be completed during the course of this year.

Konar

Konar, the second of the four dams included in the first phase programme, is of the concrete gravity type with continuous earth embankments on both sides and a saddle dyke. The water released from the reservoir will, after supplying 400 cusecs of cooling water for the Bokaro power house, provide Rabi irrigation for 68,000 acres and Khariff irrigation for 36,000 acres, totalling 104,000 acres annually. The main purpose of the dam is to supply cooling water to the thermal power station at Bokaro. The construction of this dam is expected to be completed by June 1953. The total hydro-electric generation capacity from the 40,000-kw. plant has been computed at 191 million kw. hours per annum.

Maithon

The Maithon dam, which is across the lower reaches of the Barakar River, a tributary of Damodar, is a composite structure being partly concrete and partly earthen. It is primarily designed for flood

control, but the generating station, with an installed capacity of 40,000 kw., will produce 164 million kw. hours per annum, while irrigation will be provided for 270,000 acres in the lower valley. It is scheduled for completion by 1954.

Panchet Hill Project

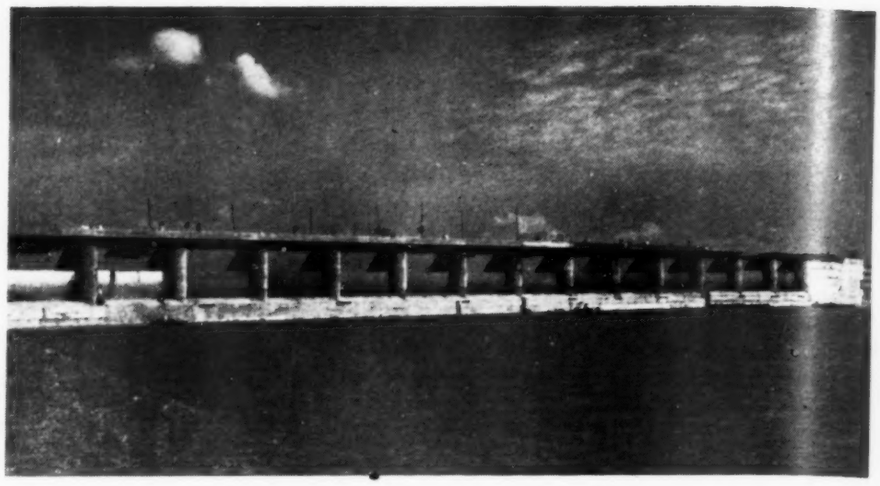
The last of the D.V.C. dams on the Damodar, Panchet Hill, is also primarily concerned with flood control. Maithon and Panchet Hill together will give complete protection to the lower valley against the worst of floods hitherto recorded. Panchet will be similar to Maithon in construction and design, and will produce 100 million kw. hours of hydro-electric energy. It will irrigate 683,850 acres of land, as against 270,000 acres irrigated by Maithon. Work on the diversion cut has already been started and the excavated material will be used for the main dam, which is expected to be completed by 1955.

The Bokaro Project

The Bokaro thermal power station is the biggest single plant of its kind hitherto erected in India and is the first high pressure station in Asia. Bokaro was practically a jungle until the corporation built 33 miles of first-class roads over difficult terrain and provided modern facilities, including a railway station, post office, school, hospital, etc. The Bokaro thermal plant is a part of an overall project of electrical generation which also includes seven hydro-electric stations to be located on various rivers. The boilers are designed to take pulverised coal and will work at a steam pressure of 900 lb. per sq. in. Coal will be transported to the station site by an aerial rope-way from the corporation's mines five miles away. The power house is designed for an ultimate installed capacity of 200,000 kw.; but the fourth unit of 50,000 kw. is not being installed for the present. Power from this first major station will meet the needs of the expanding basic industries in the area: the iron and steel works at Jamshedpur and Hirapur, the copper mines and refinery at Ghatsila, the bauxite mine at Asansol, the coal mines of West Bengal and Bihar, the new cement works and engineering industries around Asansol and Sindri.

DVC grid

The D.V.C. power transmission system comprises 375 miles of 132-kv. double circuit main transmission lines with sub-stations and sub-transmission lines. The system will serve an area of about 25,000 square miles. There are nine 132-kv. grid sub-stations and 14 33-kv. receiving stations provided in different centres.



An upstream view of the Tilaiya Dam

The D.V.C. grid will supply power to Jamshedpur, Ghatsila, Kharagpur, Burdwan, and eventually Calcutta. The D.V.C. Act provides that no one shall produce power in the Damodar Valley from stations with capacity of more than 10,000 kw. without the permission of the corporation. This gives D.V.C. a monopoly for power generation in the valley area. In addition, D.V.C. sells the surplus power from the Sindri fertiliser factory, amounting to 22,500 kw., to the coalfields and other consumers.

Barrages and irrigation

The water discharged from the four dams will be diverted into 1,800 miles of canals and distributaries by a barrage about 2,500 ft. in length and 38 ft. in height at Durgapur below the confluence of the Damodar and the Barakar. The area to be benefited with perennial irrigation in the lower valley measures 1,025,762 acres, and the valley should produce abundant food crops as the fertile alluvial soil is capable of a far higher level of agricultural production. The districts that will benefit by the scheme are Howrah, Hooghly, Burdwan and Bankura. Eighty-three miles of the canal system will be navigable and thus reduce pressure on the railways by offering alternative communication between Calcutta and the West Bengal coalfields. The canal will offer cheap transport of both raw materials and finished goods between Calcutta and the Ranigunge area, and is expected to carry an annual cargo load of 2 million tons. Digging of the canals has already commenced and good progress is being made with the barrage; the whole work is scheduled to be completed by June, 1956. There is an existing irrigation scheme which is fed from a weir across the Damodar, the area irrigated by this scheme covers 185,000 acres. The old inundation canal is not functioning satisfactorily and the present barrage and irrigation scheme will cover the entire area on the left and right banks of the Damodar. An average flow of 1,500 cusecs will be available for rabi cultivation for crops like wheat, barley, gram, pulses, potatoes, mustard, sugar cane, vegetables, etc., after completion of the irrigation scheme. Growing of non-food crops like jute, cotton and tobacco is recommended on Kharif lands without interfering with the Kharif cultivation. The extra food yield is estimated to be 216,076 tons of rice and 133,200 tons of rabi; while the total estimated cost amounts approximately to £14,600,000. For industrial and domestic use the perennial supply of water will be a great advantage.

Besides increase in food yield, there is a great scope for the development of fisheries in the lakes, for which steps are being taken. The extra fish yield computed at 50,000 maunds a year should account for £300,000.

A downstream view of the Tilaiya Dam

Soil conservation and afforestation

Soil conservation is an important aspect of agricultural development, and special attention is needed in the upper valley where the land is badly eroded. No river valley project can afford to neglect soil conservation if large storage dams are to be prevented from premature silting. In order to provide irrigation and retard the run-off, a number of small dams on the rivulets have been constructed in the upper valley. An agricultural development station at Burdwan has been set up to tackle the problems of agricultural development and to encourage improved methods of agriculture which will give better crops and assist in the conservation of soil and water. The methods used for conservation are terracing, contour ploughing, planting suitable grasses, gully-plugging, afforestation, etc. Particular attention is also being given to undertaking conservation measures in the headwaters of the Damodar where forests have been cut down recklessly and over-grazing has left the slopes barren. The corporation's soil conservation department is engaged simultaneously in mechanised reclamation as well as in land-use experiments; 5,000 acres of wilderness have already been reclaimed, while various improvements in existing agricultural methods have been introduced to ensure that the productivity of the land is maintained.

Land reclamation work is going on to enable cultivators whose lands are submerged by the reservoirs to be compensated by fresh grants, such reclamation work being now confined to the waste lands in the neighbourhood. Reclamation work is based on sound soil conservation and the building up of the fertility of the land where organic matter, nitrogen and phosphate contents of the soil are low. In the Tilaiya scheme alone, in place of 56,631 plots of old agricultural land 14,331 plots of reclaimed land will be allotted to 3,377 displaced persons to fulfil the promise of land for land made by the Government.

Durgapur Barrage under construction

Finance

The project is being financed by the Central Government of India and the State Governments of Bihar and West Bengal, but the two State Governments borrow from the centre to pay their shares of the capital required. Due to financial limitations of the Government of India, the World Bank has advanced a loan of nearly $38 million to accelerate the growth of industry and agriculture in the Damodar Valley. The original estimates prepared by the technical representatives of the participating Governments for the first-phase programme amounted to $157·5 million, and the estimates went up subsequently to approximately $189 million. The net annual return from the capital outlay on the plan is estimated to be over $39.9 million on food production and $8.4 million revenue from power, giving a net annual return of 25.6%. But of even greater importance is the economy likely to be effected in India's foreign exchange. The average import of food alone into India amounts to 3 million tons. If imports of raw cotton and raw jute are also taken into account, the total takes a colossal toll of India's foreign exchange. Above all, the Damodar Valley scheme when completed should alleviate or remove unemployment, increase industrial production and raise the standard of living. As a result, people living in the valley should no longer suffer from the effects of drought and flood.

Villagers visiting the paddy fields to be allotted to them after reclamation

National Weed Conference

A National Weed Control Conference has been arranged by the English Ministry of Agriculture for November 3, 4 and 5, 1953, at Margate. The aim of the conference is to promote an interchange of views between those engaged in research and advisory work, and farmers and others who have made a study of this subject. Many aspects of weed control will be under discussion, but special emphasis will be laid on chemical means of control in agricultural and horticultural crops.

The conference is being organised by a committee representing the Ministry of Agriculture and Fisheries, the Agricultural Research Council, the National Farmers' Union, the British Agricultural Contractors' Association (representing spraying contractors), and the Association of British Insecticide Manufacturers (representing herbicide manufacturers).

Cardaria Draba — A Globe-Trotting Weed

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With the development of modern methods of weed control, interest centres more and more in particular weed species. The weed known in England as Hoary Peppperwort (Cardaria draba) has attracted considerable attention of late years, particularly by reason of the rapid manner in which it has spread throughout the majority of temperate countries. In the following pages an account is given of the characters, manner of spread, and control of what must be reckoned one of the most troublesome weeds of temperate countries.

IN 1920, R. Robson[1] wrote of *Cardaria draba* Desv. (then *Lepidium draba L.*): 'Above ground it is as bad as Charlock, below ground it is as bad as Bindweed.' Better qualifications for a weed are difficult to imagine and it is interesting, with the evidence of another 30 years behind us, to re-examine the position today. Such is the purpose of this article.

Distribution and importance

Cardaria draba seems to have originated from Europe where it is still widely known and in some places is quite important; in France, for instance, it is listed among the weeds 'highly injurious to agriculture.' It was first recorded in England in 1809 in the Isle of Thanet, hence one of its many names 'Thanet weed'; by 1887, it was known in several parts of southern England and in Wales and was becoming of increasing importance in the eastern counties. By 1920, infestations in Essex were sufficiently serious for experiments to be carried out on its control and today Essex is not alone in this distinction. Long before this, however, England's fate was being shared by many countries all round the globe. Let us make a brief survey of its progress. In 1895, the weed was reported in Otago,[2] New Zealand, and seems to have been known in other areas there as well. By 1915, it was infesting some fields in New Zealand to such an extent that they appeared white when the weed was in flower.[3] In 1935, it joined New Zealand's list of noxious weeds and has remained there to this day.

Sometime during the 19th century it invaded Canada, and by 1896 was known in Ontario and Saskatchewan.[4] Today, it can be found in the southern parts of at least half the provinces of that country.[5] Continuing its relentless advance, it entered the U.S.A. and in 1898 was reported in New York, Washington and Colorado.[6] By 1907, it was in California, by 1918 in Nevada, by 1920 in Wyoming and New Mexico, while in Idaho it was described as one of the State's most serious weeds.[7] The present position in the U.S.A. is that *Cardaria draba* is found in nearly all the States north-west of a line drawn from Texas to Pennsylvania via Kentucky with serious infestations in six of them[8]; it is one of the six 'noxious weeds' listed in Nebraska, and both plant and seed are listed as 'primary noxious' in Iowa.

A patch of Cardaria draba—the beginnings of an infestation

In Australia, too, the weed is known in several States, including Victoria, South Australia, New South Wales, and Queensland. In Victoria, experiments on its control were already in progress in the early 1930s, while in South Australia it was reckoned as a serious pest of arable areas by 1933.[9] It is also found in Tasmania, where it is placed in Category 1 in its importance as a weed. At least two South American countries know of its presence; of these, the Argentine reports it from several areas and as being particularly aggressive in the Patagonic Valleys.[10] Thus a period of only 65 years has seen this weed spread from Europe to at least three other continents and several more countries beside.

But what of the ecology of the weed? The conditions under which it will grow are as diverse as its distribution. It is a weed of waste land and cultivation, of ploughland and grass, of light soil and heavy. It is found in irrigated areas and areas almost too dry for cultivated plants to grow; 4,000 ft. up in the Rocky Mountains is not too high for it nor sea level too low. It is therefore adaptable over a wide range of conditions.

Nomenclature

Because of its wide distribution *Cardaria draba* has a wealth of local names; a selection of these is given below, together with the countries in which they are used:

Hoary Cress—Australia, Canada, New Zealand, U.S.A.
Hoary Pepperwort—Great Britain.
White Top—U.S.A.
Passerage Drave—France.

TABLE I

	Percentage Numbers of Pods Containing—					Proportion 2-Seeded Pods to 1-Seeded
	2 *Normal Seeds*	1 *Normal Seed*	2 *Shriv. Seeds*	1 *Shriv. Seed*	1 *Shriv.* + 1 *Normal Seed*	
A	7	80	½	12	½	1/11.5
B	2	70	1	26	½	1/24
C	31	53	½	6	9	1/1.4

Turkissche-Kresse—Germany.

Perennial Peppergrass—U.S.A.

The weed itself must be carefully distinguished from two close relatives, *Cardaria draba var repens* and *Hymenophysa pubescens*, both of which are also called Hoary Cress. The easiest distinction between the three is in the shape of the pod, that of *Cardaria draba* being the shape of an inverted heart; for this reason it is sometimes called ' Heart-podded Hoary Cress.'[11]

Reproduction and dissemination

Such rapid progress round the world makes the means of spread of the weed of great importance. Within a small area the spread and persistence of the plant are probably largely due to its very strong creeping root system in which it stores large quantities of food; but its dissemination from area to area and country to country would seem to be mainly by seed. It is probable that its journey to and about America was made mainly as a seed impurity and this may be true of other countries as well. Alfalfa seed seems to be the accepted culprit, but others, including the seeds of beet, grasses, flowers, and clover have also been blamed. Seed impurities are not the whole story, however, and other influences have played their part. A number of original infestations have been reported from areas around shipping ports, *e.g.*, Washington and New York, which suggests that the seeds have come as impurities in the ship's ballast or cargo. Dirty hay has also come under suspicion, and it is of interest that the original outbreak in England is attributed to seeds carried in the stuffing of soldiers' bedding or even in the fodder for their horses. Groh[4] has an interesting record that the weed was known in Canada in 1878 as a garden escape and that it may have been grown as an ornamental plant; Hughes[2] in New Zealand also records seeing it grown in gardens and shrubberies, although why this should be one cannot imagine, since the plant has little beauty.

Seed production and germination

Many writers are agreed that the plant produces large amounts of seed and counts made by the writer show a potential production per plant, according to its size, of between approximately 50 and 3,000 seeds. The writer has also noted, however, that it is not uncommon for plants to fall considerably short of this potential production. Counts on 92 plants collected from three different centres (A, B and C) in Hertfordshire, England, showed the following average numbers of ' fertile ' pods (*i.e.*, pods in which the seeds had developed) per raceme: A, 0.3; B, 0.2; C, 5.7, whereas the *total* number of pods on a raceme (counts made at one centre only) vary between 5 and 15 with an average around 8. From the plants collected at each centre a sample of about 200 pods was taken at random and the numbers of normal and shrivelled (Shriv.) seeds present in the pods noted. The results, expressed in percentages, are given in Table I.

A normal pod should contain two seeds, but as can be seen there was a far greater tendency for pods to contain only one seed. Groh,[4] in Canada, has also noticed this tendency to partial sterility and records a similar observation by another worker. Germination tests on samples of seed from these centres showed that only in the case of C was the germination over 50%. Taking into account the failure of some pods and seeds to develop, the incomplete development of others and the low germination of seed seems that the production of viable seeds by *Cardaria draba* may sometimes be considerably less than is at first supposed.

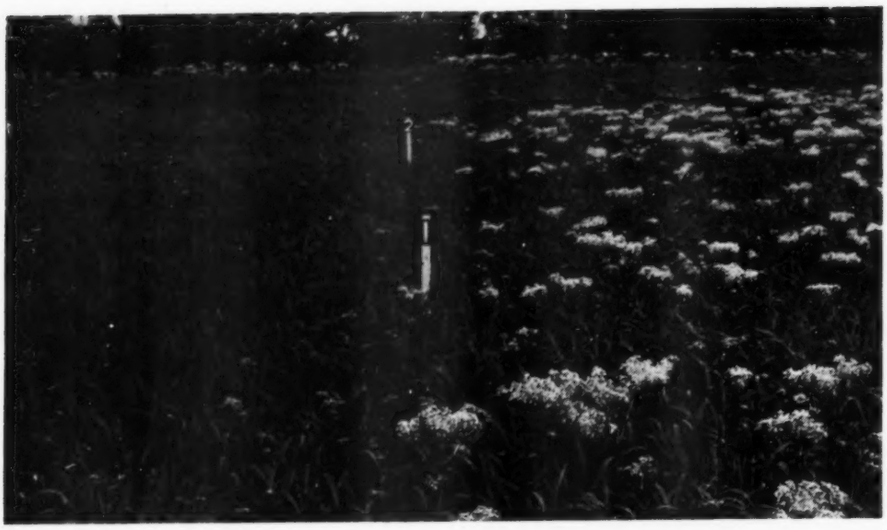
Cardaria draba in a cereal crop

Control methods

Attempts to find a control for *Cardaria draba* have been many and varied, and only the briefest summary of the more important can be attempted here.

Smother crops have had varied success,[12 13] but dense seedlings of sweet clovers and certain grass mixtures do seem to have held the weed in check in some cases, particularly when used in conjunction with previous heavy cultivation. Grazing by sheep and hogs has also been used to good effect according to some writers,[6] but there seems doubt about the

A bad infestation of Cardaria draba



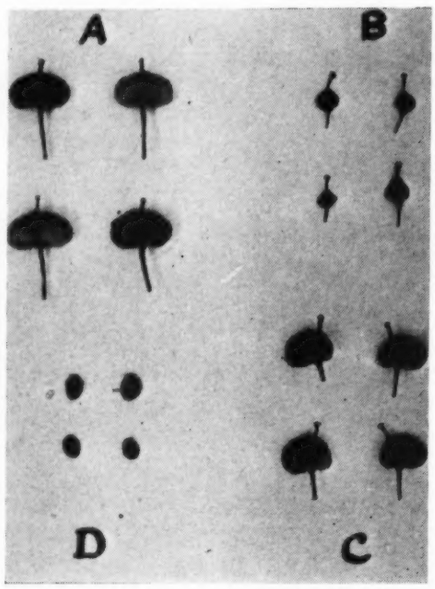
Control of Cardaria draba with MCPA, the area to the left of the numbered sticks being treated with MCPA at 4 lb. per acre as a spray and that to the right being untreated

weed being eaten by cattle.[14] Flooding has only been successful in irrigated areas, provided the plants are completely covered.[12]

Cultural control methods are not normally very successful. Good spring cultivations before sowing a crop seem to keep the weed in check, but never to eradicate it. A number of cases have been recorded in the United States where control has been achieved by cultivations of a very severe nature, *e.g.*, cultivating once a fortnight for two years.[15] Hand pulling is an obvious remedy, but this will only remove the tops and leave the roots to grow again.

Herbicides

Since as early as 1920 various chemicals have been employed to kill this weed. They included copper sulphate, sodium chlorate, ammonium thiocyanate, carbon disulphide, sodium chloride, acid lead arsenate, and DNOC. Most of these were either ineffective or only killed the tops, although in Australia good kills were recorded using sodium chloride and acid lead arsenate.[16] The advent of the new weedicides based on the growth - regulating substances, 2 - methyl - 4 - chlorophenoxyacetic acid (MCPA) and 2:4-di-chlorophenoxyacetic acid (2:4-D), opened up new possibilities for the control of this weed. Blackman and his colleagues,[17] working on infestations in heavy soil in England, found that a large measure of control could be obtained with both MCPA and 2:4-D by spraying a sequence of winter-sown cereal crops; their results were particularly interesting in that they showed these materials to be most effective at different periods in the plant's growth, the former at pre-budding stage and the latter at the flowering stage. The present writer[18] carried out experiments on lighter soils, and for these recommends a series of spring cereal crops sprayed with 2 lb. of MCPA per acre each year; in this way the killing power of the weedicide is combined with the good effects of spring cultivation. With the use of MCPA and 2:4-D, provided that attention is also given to planning such a rotation of crops that these substances can be used repeatedly over a period of years, it seems that at last we may have gained the upper hand of this globe-trotting weed.



Pods and seeds of Cardiaria draba. (*a*) Normal pods containing two fertilised seeds. (*b*) Shrivelled pods containing no fertilised seeds. (*c*) Pods containing one fertilised seed. (*d*) Normal seeds

Some of the information in the foregoing article has been received in private correspondence to the writer, who gratefully acknowledges the help thus given.

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OEEC Grassland Team Visit

A team appointed by the Food and Agriculture Committee of the Organisation for European Economic Co-operation have spent two weeks in the United Kingdom discussing pasture and fodder production with British experts and officials. The team—comprising Mr. J. T. Kernohan (Belfast University, seconded to FAO), Dr. Woodhouse (United States of America) and M. Mahou (France)—are part of a larger mission which is conducting a survey of pasture and fodder production throughout north-west Europe with a view to making a report to OEEC. Mr. T. E. Williams of the Grassland Research Station, Hurley, is one of the members of another team which is visiting other European countries.

It is hoped that the mission's reports will help to stimulate the development of fodder supplies in Europe and so help along the much-needed expansion of agricultural production throughout the whole area.

Pasture land near New Plymouth, Taranaki Province, North Island

New Zealand Farming

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The following account of the agricultural situation in the Dominion of New Zealand contrasts the position in that country with the situation in Great Britain, and will, no doubt, be of interest to farmers in other parts of the world.

NEW ZEALAND covers just over 100,000 square miles and is therefore very similar in area to the United Kingdom. This circumstance, together with the intensely British character of its people, seems often to give rise to the impression that the Dominion can be regarded simply as a ' down under ' edition of the British Isles. But, in a physical sense at least, the differences are more noticeable than the similarities. One might, indeed, make topographical comparisons between New Zealand and Scotland (or even Wales), but England's typical broad and accessible acres are very different in character. New Zealand is a country of sharper contrasts. Behind the broad plains of Canterbury are the towering snow-topped Alps running uo to Mount Cook's 12,000 ft. In the North Island are three volcanoes, and also regions of thermal activity. Great rivers and lakes lend variety and delight the sportsman. Areas of dense native ' bush ' contrast uneasily with forests of exotic softwoods.

Moreover, the Dominion is a mountainous country with less than one-quarter of its surface lying below 650 ft. The proportion of ' easy ' farming lowlands is, therefore, very limited, such land being confined mainly to coastal strips and river valleys. There is, of course, a large area of good—or potentially good—hill country, but much of it is very steep and not easy of access. Such land is consequently difficult to fertilise and improve.

It is not easy to bring out in exact figures the contrast with the United Kingdom which New Zealand offers. But it may help to say that, whereas the United Kingdom has about 31 million acres of crops and grass (50% of the whole), New Zealand has about 19 million acres (30%) of land in these two categories, of which about 9 million acres is ' surface-sown ' hill country. Moreover, one estimate is that New Zealand's ploughable land does not much exceed 8 million acres.

Climatic differences between the two countries are also very pronounced. There are some very wet areas in New Zealand, and one semi-arid in character, but, in general, the rainfall of the farmed lands is of the order of 30 to 70 in. and evenly distributed. Drought conditions occur in some parts in most summers, but there is no record of any district being without rain for longer than two months. A great deal of the country enjoys 2,000 or more hours of sunshine per year.

New Zealand has a temperate climate. The winters are milder than in Britain and continuous snow on the lower ground is unknown. Even at the coldest latitudes, the mean annual temperature at sea level is about 50° F. Britain stretches roughly between 50 and 60 degrees of latitude, New Zealand lies nearer to the equator, *i.e.*, between 35 and 47 degrees. Nor are summer heats excessive, and nowhere in the Dominion is it necessary to house cattle at any season, even at night. Another striking result is that, for a given altitude, potential productivity is higher than in Britain. As a broad generalisation, observation suggests that the kindliness of the climate is equal to an advantage of 2,000 ft. or so; in other words, much land in New Zealand at 3,000 ft. above sea level offers the production potential of land at 1,000 ft. in Britain.

The shortness of New Zealand's history under British settlement is not always realised. Although first visited by Europeans in 1642 and rediscovered by Captain Cook in 1769, the development of the country has been packed into the brief span of the last 100 years or so. A great deal of the work was done by a working population of much under half a million, in times when modern high-powered machinery was not available, and no account of the farming of the country should omit a tribute to those pioneers who carved farms from virgin land and built the Dominion's roads, bridges, railways, wharves and cities. The challenge to New Zealand's present population of under 2 million is the need for a comparable effort in the second 100 years; if that challenge is taken up, the country's future is bright indeed.

Farming's contribution to the national economy

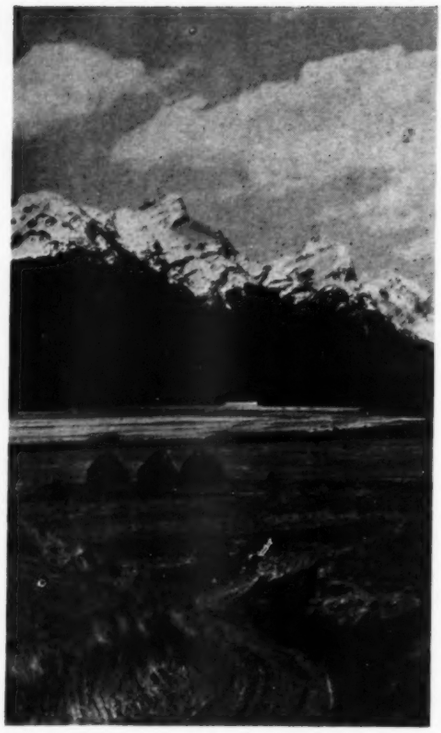
The importance of farming to New Zealand's economy is such as to make it the envy of farmers, farmers' advisers and agricultural administrators in nearly all other countries. Here is a land whose

farmers and foresters contribute about 60% of the national production of goods (as against perhaps 8% in Britain) and 96% of its exports. Farmers are also important numerically because, with their employees, they constitute about 20% of the working population.

The national economy has at least two other characteristics which are highly significant. First, the proportion (70% by volume) of agricultural products exported is exceptionally high. As a result, two-thirds of the farmer's income comes from exported produce; indeed, the feeding of New Zealand's population is, for the most part, the least of his burdens. This state of affairs enables the specialised production of a small number of standardised commodities to be exploited to the full. And these advantages are the more readily obtainable in that, not only is export the main outlet, but the market is to a large extent a single one, that is, the United Kingdom. A subsidiary benefit from this specialisation is that New Zealand's dairy and meat industries can be (and are) supported by highly efficient dairy factories, cold stores and freezing works which are able to benefit by the large throughput and modern methods. It is not possible here to do justice to this vitally important processing section of the country's food production. The second point is that New Zealand's economy depends on the importation of manufactured goods in exchange for primary produce. Thus her farmers not only feed the domestic population but, through overseas trade, enable the Dominion to enjoy the desirable standard of living which goes with the consumption of a high volume of processed goods. This dependence on exports, and more particularly on exports of one type (agriculture) has, of course, its undesirable side, in that it makes New Zealand's prosperity peculiarly vulnerable to external fluctuations in the prices of primary products.

Emphasis on grassland farming

One might, perhaps, make two generalisations about New Zealand's farming. First, it is highly specialised; secondly, it is fundamentally grass farming. Only 2% of the occupied land is under arable crops and the majority of farmers are thus engaged in the conversion of grass into livestock products. Generally speaking, the soils of the Dominion are not inherently very fertile. Progress in pastoral farming has lain primarily in stimulating clover growth by the application of phosphates and lime, and reaping the benefit of the resulting nitrogen-fixation in the increased growth of improved strains of grasses. So



Pastoral scene, Dart Valley, Wakatipu

successful is this strategy of exploiting sun, rain, phosphates and clover that, at the Dominion's present level of farming intensity, it is usually unnecessary to apply nitrogen to grassland. Costs of production agreeably reflect this saving. Thus, to what must be a unique degree, New Zealand's economy rests on those mysteries which go on inside the green leaf.

Climate adds much to the New Zealand farmer's chances of making the most of his grassland. In the North Island, grass grows (at reasonable altitudes) for almost the entire year, and well-managed, improved pastures may yield up to 12,000 lb. of dry matter equivalent per acre per annum. Such grass is producing about 1 ton per acre per year of protein—an interesting thought for British farmers who are striving towards self-sufficiency in livestock feeding. The result of this state of affairs is that, on good land, a dairy cow can be maintained on as little as 1 to 1½ acres without bringing any purchased foods on to the farm at all. This means self-contained production of the order of, say, 250 lb. butter fat per acre, *i.e.*, 500 gallons of milk with 5% butter fat. In some areas of the North Island green crops for use in winter or during periods of summer drought are grown, but in others adequate results are obtained purely from grass (with, perhaps, the aid of lucerne), some of which is conserved as hay or silage. There is, indeed, a noticeable tendency to minimise even hay and silage-making for winter and spring use by conserving grass (*in situ*) in autumn and making the most of it by feeding it off, in due course, on a strictly rationed basis, with the aid of the electric fence. Under the conditions described, there need be little ploughing except for grass renewal, and only a minimum of cultivation equipment, if indeed any at all, has to be owned by the farmer. The economics of dairying in New Zealand is also simplified by the fact that it is seasonal. Thus the cows calve in spring and their period of milk production coincides, for the most part, with maximum grass growth. The beneficial effect of this on New Zealand's costs of production makes one wonder if, in the long run, British farming may not have to follow a similar course and rely more on summer production of livestock products and the preservation of the excess for winter consumption.

The North Island conditions also favour sheep farming. Good land will carry up to six or seven ewes to the acre (plus their lambs) all the year round, without the use of any foods not grown on the farm. A high proportion of such lambs will be fit for slaughter at 30 to 40 lb. dead weight by midsummer, *i.e.*, straight off their mothers.

The South Island is more like Britain; here, so to speak, nature does less of the work, and much greater provision has to be made for supplementary crops (particularly swedes, turnips, marrowstem kale and rape) for winter feeding. Yields from good pastures would probably be of the order of 6,000 lb. of dry matter per acre. But, even in the South Island, purchased concentrates are not used to any extent, cattle are not housed and, in the more favourable conditions, output of livestock products per acre is still very high.

High output per man

The high productivity of her best pastures, the methods of livestock husbandry practised, and the general economic advantages which attend young countries with a high ratio of land to labour, have enabled New Zealand to attain superiority in output per man (especially of livestock products). That this is so has been shown by various economists, whose calculations indicate that New Zealand's farm output per man is spectacularly higher than that of most other countries. It may be said that in fact the aim of the New Zealand farmer is high livestock output per man rather than high output per animal. This is in contrast with present agricultural policy in Britain, where limited and national financial problems dictate intensity of production, even if it entails heavy

labour requirements. As a result of the high output per unit of labour, costs of production of livestock products in New Zealand are, by British standards, such as to excite envy. One man looking after and milking 50 cows on his own, or tending 1,000 breeding ewes, or shearing 200 sheep in a day, are examples of the high order of efficiency in the use of labour which spring to mind. At the present time (May, 1952), New Zealand farmers are receiving approximately 1s. 4d. per gallon of milk (*i.e.*, summer milk) for cheese-making, 62s. per live cwt. for prime beef, 1s. 5d. per lb. dressed weight for first-quality 'milk' lamb, and some 40d. per lb. for cross-bred wool. And these prices serve to cover costs in spite of the fact that cash wages are higher, the value of land probably about the same, and the cost of many requisites higher than in Britain.

In achieving such low costs, mechanisation has played a part second only to climate and intensive grassland management. The necessity born of isolation has made the New Zealand farmers extremely fertile in the development of labour-saving mechanisation, which is, of course, something more than the mere replacement of horses by tractors. On the latter score, however, New Zealand is said to be among the three most highly 'tractored' countries in the world. The distribution of electricity is extraordinarily complete, one of the features of the country being its hydro-electric development. There are 100,000 electric motors on the country's 90,000 occupied holdings, so that one may guess that the proportion of farmers without a public supply of electricity is small —probably less than 10%. One result is that farm kitchens are well supplied with electrical appliances, and undoubtedly play a part in combating the lure of the town. The telephone is virtually universal on farms, and much use is made of 'party' lines.

The broad pattern of New Zealand's livestock husbandry is the same as in Britain; the hill country is the reservoir of beef cattle and breeding sheep, and there is the same broad flow of stock from the breeding grounds to the fattening country. But the number of breeds is very much less.

Sheep

In sheep farming, the Romney breed is paramount in numbers and in importance. Whereas in Britain the bulk of fattening sheep and lambs are produced by crossing ewes which are themselves the product of a first cross, in New Zealand one of these steps is normally omitted. Thus the Romney ewe not only replaces herself but also produces first-cross lambs for fattening. Of the fat lambs produced, some are themselves 'pure' Romneys, and the remainder are by rams of the Border Leicester, English Leicester, Suffolk, Ryeland, Dorset Horn, and Southdown breeds. The last named is heavily in the majority and is generally regarded as setting the standard for the production of New Zealand's well-known small, and outstandingly uniform, export lambs. When it is added that Merinos and fine-woolled Halfbreds are used extensively on the very dry, pastoral South Island uplands, New Zealand's own dual-purpose breed (the Corriedale) under intermediate conditions, and a few Cheviots on some of the poorer, wetter North Island hills, the sheep story has virtually been told. It is an interesting point that the two breeds—Romney and Southdown—on which New Zealand's fat-lamb industry now so largely rests—are not, numerically, of leading importance in Britain.

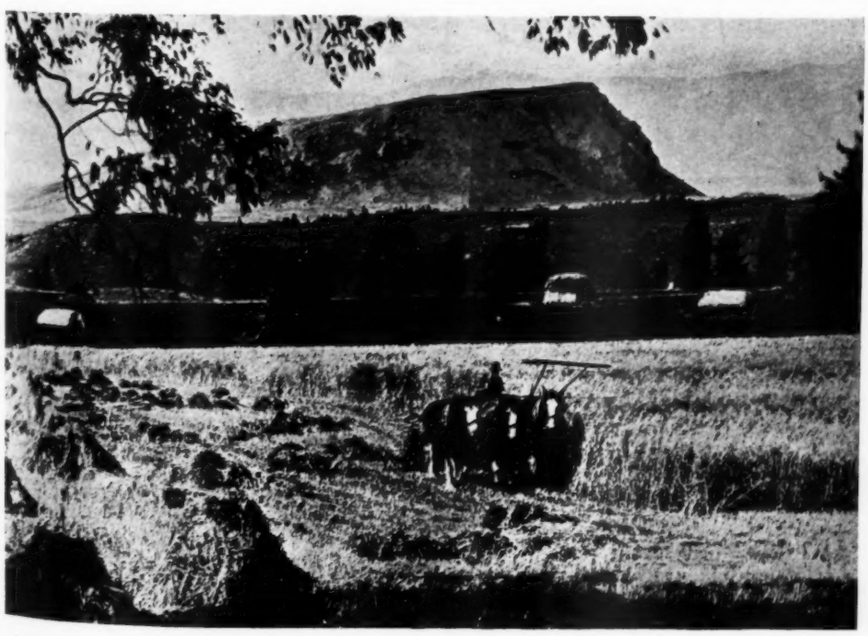
It is difficult to overstate the importance of sheep in New Zealand livestock farming. The Dominion now carries about 35 million sheep over the winter (18 to every person in the country), and when the lambs are added in summer the obvious density of the sheep population is a source of wonderment to most visitors. Wool is, of course, one of the Dominion's main sources of wealth. Its production is treated with corresponding respect and with close attention to detail, both in breeding and handling.

Beef and dairy cattle

The beef industry which, in the past at least, has been in most areas little more than a half-hearted adjunct to sheep farming, rests mainly on the Aberdeen-Angus and Hereford breeds. Shorthorns also play a part, and the Galloway breed has just appeared in the Dominion. The number of beef cattle is now increasing slowly and it looks as if they will play a bigger part in future. Such a development would be a good thing, because there is little doubt that more beef cattle could be carried with advantage. The resumption, when conditions permit, of the export of chilled beef will have a highly important bearing on the future of beef production in the Dominion.

The main breed used in the dairy industry is the Jersey, which constitutes about 85% of all dairy cattle. But the Friesian, Ayrshire and Dairy Shorthorn also play a part, the first-named mainly in producing milk for liquid consumption. The dairy industry is, of course, organised on a co-operative basis which has served it well. New Zealand turns about 90% of her milk into dairy products, against Britain's 15% or less. This season (1951-52), for the third consecutive year, the output of butter fat will be a record. The number of dairy cows is approaching the 2 million mark and seems to be still increasing.

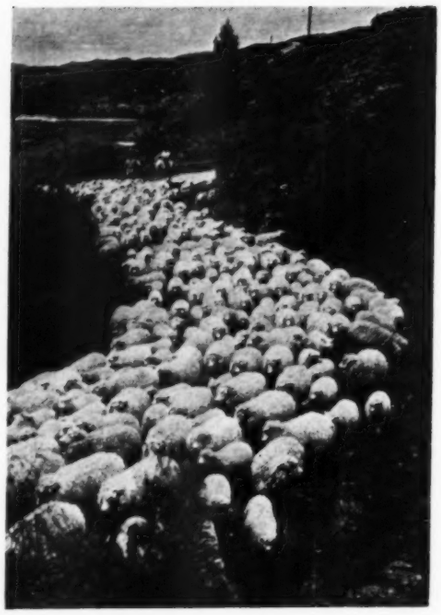
Not many New Zealand stockmen would seek Romney or Jersey blood in England, so successfully have these breeds been evolved to suit local conditions and so great now are the numbers available. But in the case of other breeds, the excellence



Harvesting oats near Lake Wanaka

of what the best British pedigree breeders have to offer is gladly acknowledged, and a considerable number of importations are made. In particular, an increase in beef production would make for an expanding outlet for high-class beef bulls from Britain.

Facilities for the efficient handling of livestock are a feature which warrants study and imitation. The layout and construction of sheep pens and cattle yards have been studied with minute care, and highly serviceable designs have been evolved. The New Zealand 'wool shed' provides for labour-saving sheep shearing and the efficient handling of wool under ideal conditions.



Bringing sheep into yards for shearing

Arable crops

New Zealand makes no pretensions to be a large-scale producer of arable crops, although the export of wheat and other crops was important in its very early days. As against the United Kingdom's 14 million acres of crops and fallow, the Dominion has only about 1 million acres in this category. The West Riding of Yorkshire has almost as big an acreage of wheat as New Zealand, more than twice the acreage of potatoes and greater acreages of both oats and barley. Crop production in New Zealand aims at satisfying domestic requirements, but in the case of wheat considerable imports are also made. While cropping plays a vital part in the economy of parts of the South Island, both climatic and economic influences are tending to make the New Zealand farmer turn away from the plough and devote himself more and more to grass and livestock. Nevertheless, because of mechanisation, crop output per man is high. Average yields per acre are on the whole slightly less than those of Britain, and prices are little below those paid to British farmers.

New Zealand has developed a highly important production of grass and clover seeds, some of which is exported. Production is from grass, rather than on an arable basis, and the acreage harvested can therefore be flexibly adjusted according to season, stocking and price trends. The Dominion's official schemes for grass and clover seed certification are first class and merit close study.

A hay baler in operation on a North Canterbury farm

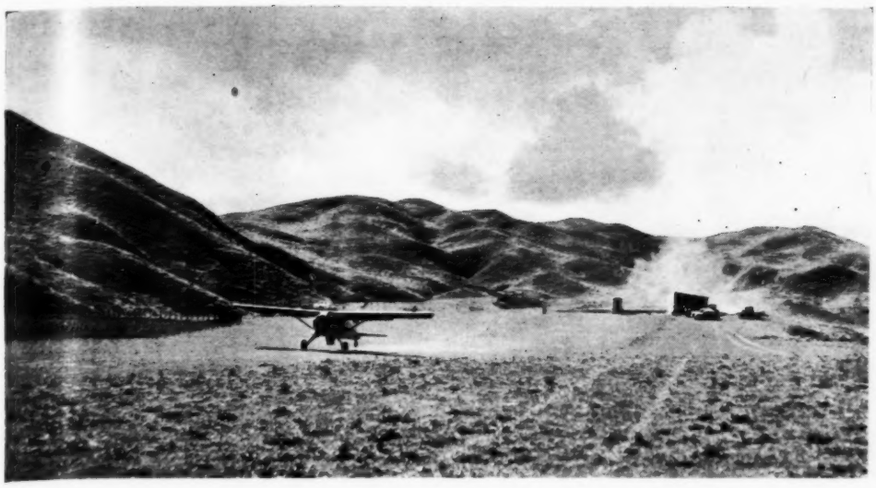
Some other aspects

Poultry farmers almost satisfy local requirements, but there are sometimes local and seasonal supply problems. Bee-keepers produce an export surplus of some 400 tons of honey. Tobacco is both grown and cured, and nowadays over a third of the leaf smoked in New Zealand is home-grown. Enough hops are produced to satisfy the country's own needs and provide for a small export. Market gardening supplies all the fresh vegetables required, and there are signs of aspirations towards an export trade. The fruit industry (which includes the production of grapes for wine-making) is important, and up to 1,500,000 cases of apples are exported annually. There is also a sizable production, for domestic use, of citrus and sub-tropical fruits. The growing of linen flax was instituted as a war-time measure and a considerable export of fibre and tow was achieved; now the industry continues on a reduced scale. Nevertheless, New Zealand flax (*Phormium tenax*) is providing the raw material for over half New Zealand's requirements of wool sacks, and is thus of especial importance in these days of jute shortage.

Having dealt with the various branches of the Dominion's farming, perhaps as good a way as any of summing up the relative importance of the various sectors of production is to record that, in 1949-50, the gross farming income of £181 million was estimated, in round figures, to comprise the following main items: Arable products (including fruit, vegetables, etc.) £18 million; dairy produce, £60 million; sheep, £22 million; wool, £58 million; and beef cattle and pigs, £12 million.

Land tenure

Land tenure calls for a brief mention. The statistics suggest that about half the land being farmed is occupied by owners and half by tenants. This, however, gives a wrong impression of the position because the acreage of leasehold land is swollen by the existence of large holdings of high country (under permanent unimproved pasture) held from the Crown, under a variety of leases, by a small number of tenants. Moreover, Crown leases carry perpetual rights of renewal and, in some cases, of purchase, so that the difference between this form of tenancy and ownership is legal rather than practical. On the other hand, the majority of ordinary farms are freehold and occupied by their owners. The administration and letting of Crown land is covered by statute, but the conditions of leasing other land is a matter for individual covenant between the parties concerned, and for common law. There



An aircraft takes off to drop fertiliser on rugged country which cannot be top-dressed from the ground

is no equivalent in New Zealand of the agricultural holdings legislation in British agriculture. Nor is there any counterpart to the ' good farming ' and ' good management ' obligations laid on occupiers and owners of land in the United Kingdom by the Acts of 1947, 1948 and 1949. The planning of land use is still in its formative stages.

A significant amount of land is owned by Maoris, and its full utilisation presents its own set of problems. With co-operation between the owners and the State, considerable strides are being made in increasing the area of this land.

Possibilities of continuing expansion

All New Zealanders are interested in the prospects for agricultural expansion. Since the late 19th century farm production has increased at least fivefold, the rate of increase naturally being quickest in the earlier years when rapid strides were made in opening up new country and in consolidating markets for refrigerated meat and dairy produce. The official statistics, first published in 1928-29, show that, at the outbreak of World War II, the volume of farm production had crept up over the previous ten years by about 25%. In the ten years since the war the rate of increase has been of the same order. New Zealand farmers would give a generous share of the credit for this achievement to the Dominion's agricultural scientists and the Department of Agriculture's farm advisory services.

It is generally held that a similar rate of increase is to be expected in the medium-term future without any fundamental changes in agricultural policy or extraordinary measures of assistance to farming. But, equally, a great deal more would be theoretically possible if the necessary proportion of the national resources were deployed in agricultural production. This involves economic and political decisions which must determine the pattern of the country's future development. At any rate, all are agreed that production can be much increased, and Government and producers' organisations are giving much thought to means of achieving this.

The main field for farming expansion lies in increasing the acreage of good productive grassland; on the hill country a most potent weapon in this programme is aerial top-dressing, which is already being provided by private contractors on a significant scale. There is really no alternative way of getting phosphates applied to much of the steep and rugged hill country, and aerial application is undoubtedly an important milestone in the country's agricultural history.

A very worthwhile contribution to extra production can be, and is being, obtained from the development of virgin land. In addition to the private enterprise, the State itself is pursuing this work at the rate of some 40,000 acres per year. Since the war ex-Servicemen have been given first claim on new farms made available in this way, and a start is now being made to meet the heavy demand for farms from civilian candidates.

Shortage of labour

The Dominion has, of course, its farm labour problems. Although mechanisation seems largely to have compensated for the reduction in the number of people working on the land since 1939, the remoter areas, especially, are often hard pressed to get essential work carried out. Any substantial agricultural expansion would undoubtedly demand more labour. The provision of more houses in rural areas is therefore of fundamental importance. On the other hand, the New Zealand farmer likes to make himself as independent of labour as possible, and the percentage of the farm labour force which is hired is less than in Britain. Although this gives a degree of freedom, it is, in some ways, a weakness that the Dominion lacks the pool of labour to be found in farming villages of England, and production on individual farms sometimes tends to follow that of the farmer's own age and strength more than, ideally, it should. The task of increasing production from a farm may lose some of its thrill when the *entrepreneur* has to tackle the work with his own hands. New Zealand has statutory minimum farm wages, but as hours of work on farms are not expressly laid down, the payment of overtime as such does not arise. In the context of farm labour supply, the Maori worker must receive mention. In the North Island, particularly, he plays a stalwart part, and the great seasonal tasks, such as sheep shearing, could not be accomplished without him.

New Zealand's link with Britain

The farmers of the Dominion are justifiably proud that they now send Britain some 350,000 tons of carcass meat and 230,000 tons of dairy produce annually. Indeed, of Britain's total imports, New Zealand now provides 42% of the carcass meat, 52% of the cheese, 37% of the butter, 53% of the dried milk, and 26% of the wool. This is a great achievement on the part of a comparatively small force of 90,000 farmers. Were they to double their output of meat, butter and cheese the present indications are that Britain could absorb it easily, in addition to the hoped-for expanded production from her own farms.

It is fitting to say in conclusion that farmers share with all New Zealanders a strong sense of their close kinship with Britain and are most desirous of doing their utmost to meet Britain's food needs. It is a happy thought that the Dominion's export production fits in so neatly with Britain's own agriculture. In addition, the opposite seasons in the southern hemisphere enable commodities like meat, dairy produce and apples to reach the British market at the times when home-grown supplies are at their lowest ebb. Thus Britain's well-being and New Zealand's prosperity go hand in hand, and economic forces give a solid basis for the ties which draw the two countries so closely together.

(*From ' Agriculture.'*)

Photos: High Commissioner for New Zealand.

Green Manuring in India and Pakistan

DR. C. DE FELLNER

Green manuring, generally conceded to give good results in temperate climates, has given more variable results under tropical conditions. In India recent experience favours the practice. In this paper the author, who has recently visited India, summarises recent opinion and experience in that country.

TO supply the soil of the Indian subcontinent with organic manures is one of the major problems of Indian agriculture. Indian soils are very poor in nitrogen and organic matters. Their average nitrogen content ranges from 0.03% to 0.07%, against 0.1% to 0.17% in European and American soils. As for organic carbon, they contain 0.6% compared with 3% in Europe or in the U.S.A. This short review is intended to give some information upon one possible solution of this important problem. It is not in any way complete, and is based on information gathered on visiting Indian and Pakistani agricultural research stations.

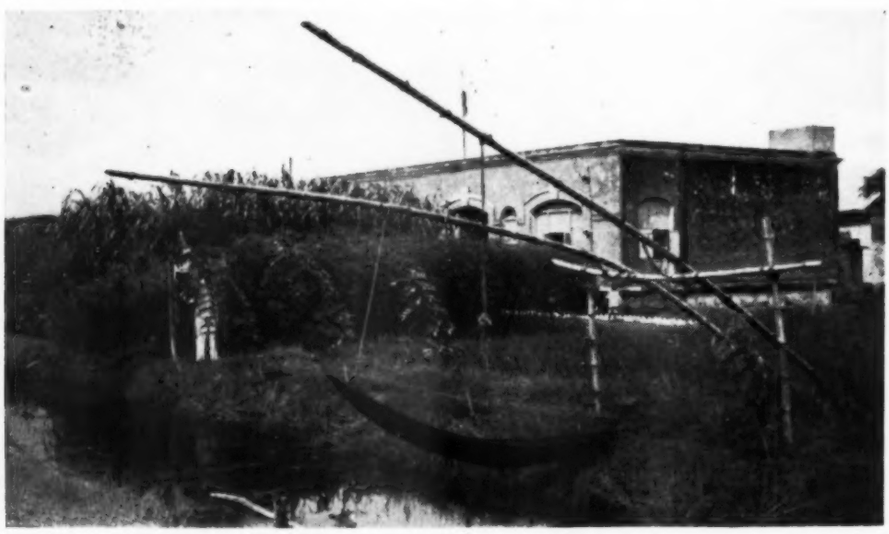
For different reasons, beginning with the vegetarian habits of the population and their cow idolatry, down to the well-known fact that yields of plant products per acre will feed more hungry mouths than if they were transformed into animal products, animal husbandry is a somewhat neglected part of agriculture. There is great waste of farmyard manure, since animals live mostly in the open and much valuable manure gets lost, the most important part of what is gathered being used for fuel.

Green manuring

It seems, therefore, that the only satisfactory substitute could be green manure. In fact, green manuring has been an ancient practice all over India for many hundred years, but the scientific aspects of the problem have not been studied before this century, and it is only recently that some advance in this respect has been achieved.

The simplest form of green manuring—called green-leaf manuring—is the burying of leaves of trees growing either in the vicinity of the field or on channel banks or bunds. This is quite different from the practice of growing plants for green manuring purposes on the field itself and turning them under at the right time for the following crop to benefit from their manuring effect.

The characteristics of a plant well suited for green manuring should be rapid growth, a high yield of succulent organic matter, the capacity to do well on poor soils and also under waterlogged conditions, low water requirements and a high moisture content to facilitate decomposition in the soil. If possible, legumes should be given preference. If the plant could be used also for fodder or as fibre plant, it would be a definite advantage.



Water-raising apparatus at a rice research station in West Bengal

Plants suitable for green manuring

Legumes

Sunn-hemp or Sann-hemp (*Crotalaria juncea*) is the plant most extensively used for green manuring all over India and also in some parts of Pakistan. It is generally used as green manure for rice and sugar cane, and is grown also as fodder. Some special strains produce remarkably good fibre, and seeds can be fed to cattle. The seed rate is from 30 to 50 lb. per acre. It is easy to grow—erect, with little branches, it reaches a height of 4 to 5 ft. and is generally cut before flowering, when 60 to 90 days old. It can be grown as a rainfed or as an irrigated crop.

Other varieties of crotalaria are also being used for green manure. Of these, *Crotalaria striata* is the most popular, especially in moist regions. It is a herbaceous shrub, 3 to 4 ft. high. The seed rate is from 30 to 40 lb. per acre. Rainfed, it is used generally as green-leaf manure. The leaves can be cut after three months. It gives two good cuttings of green matter, of about 8,000 to 15,000 lb. each, and is used also for mulching on tea, coffee and rubber plantations. *Crotalaria verrucosa*, a branching herbaceous annual, can be used also on saline soils.

Sesbanias are another important family of plants suitable for green manuring. *Sesbania aculeata* is especially suited for heavy soils. It can be grown on low, wet and badly waterlogged and also on saline soils. The approximate seed rate is 10 to 20 lb. per acre. Rainfed, it is ready for cutting within 6 to 8 weeks. Soft and succulent in its early stages, it gets woody very soon and has therefore to be turned under in time. *Sesbania aegyptiaca* can also be grown under waterlogged conditions. It is used on the acid soils of tea plantations in Assam, and is a good fodder and fibre plant.

Moth (*Phaseolus aconitifolius*), Black Gram (*Phaseolus mungo*), Mung or Green Gram (*Phaseolus mungo radiatus*) are all used for green manure. A very important variety, the Phillipesara (*Phaseolus trilobus*) is grown mostly in South India. It is a trailing herb with prostrate branches, most valuable and nutritive as green fodder, generally broadcast into the standing crop of late rice, at a rate of 15 lb. per acre. After 7 to 8 months it can yield about 25,000 lb. Other pulses rather popular for

Cowpeas and Sunn-hemp

green manuring are cowpeas (*Vigna catjang*) and guar (*Cyanopsis psoraliodes*). Cowpeas do well on poor soils and yield an excellent fodder. Guar is also used for fodder. The seed rate of the latter is about 20 lb. per acre.

Wild indigo (*Tephrosia purpurea*) is used all over South India. The seed rate is 15 lb. per acre. Rainfed, of slow growth, it is used as a single crop on wet land. It has to be cut before flowering. Another species of this family is the *Tephrosia candida*, a perennial shrub growing also on high ground up to 4,000 ft. It is generally planted in 1-ft. rows, and is ready for cutting after one year; it gives four cuttings yearly. Tam (*Indigofera endicaphylla*), a trailing annual, grows also on high ground up to 6,000 ft. The seed rate is about 20 lb. per acre. It is fast growing, and the leaves should be cut within 3 to 4 months. *Cassia tora*, an annual, grows wild up to 4,000 ft. The seed rate is 15 lb. per acre. The leaves should be cut before flowering. Velvet beans (*Stizolobium deeringianum*), a fast growing plant, is used generally for fodder but also for green manuring, giving bulky, easily decomposing crops.

Some winter legumes are also used. Berseem, mostly grown for fodder, giving normally six cuts, is a good green manure plant. If used for this purpose, the fourth cut is generally turned under. Senji (*Melilotus parviflora*), Fenugreek (*Foenicum graecum*) and *Lathyrus sativus* are also extensively used, but only under irrigation.

Non-leguminous plants

Hemp (*Cannabis sativa*), sunflower, sorghum and maize are incidentally used for green manuring.

Green manure trees and shrubs

Of these, the following may be mentioned: *Erythrina lithosperma*, *Erythrina indica*, *Gliricidia maculata*, *Hibiscus tiliaceus*, *Leucaena glauca*, *Calopogonium mucunoides*. These are rapidly growing trees and shrubs of moderate height. They can be lopped after the second year and used for green manuring.

Burying green manure

The burial of green manures is a simple operation done with ploughs or disc harrows. As a rule, the green manure crop has to be buried deeper on light soils than on the heavier types. It is also rather important to bury older or woodier crops nearer to the surface as decomposition seems to be faster if more oxygen is available. A thorough study must be given to the ' timing,' *i.e.*, the interval needed for decomposition. This is indeed the crucial point of green manuring, as under tropical conditions a decrease of nitrogen or a reduction of the nutrients produced by the green manuring can happen rather suddenly, with the result that the beneficial effect of green manure is lost, and even the yield of the following crop might be affected. On grounds of general experience, it can be assumed that 8 to 10 weeks should be the right interval, especially for Sunn-hemps and Sesbanias. Berseem needs much less time for decomposition, 2 to 4 weeks seem to be sufficient. Undoubtedly, the risk of green manuring is chiefly connected with the uncertainty of moisture content of the material.

The economics of green manure grown under irrigation are yet to be studied, but it seems to be a paying proposition, especially if the improvement of the soil structure is taken into account. One of the reasons why the beneficial influence of green manuring is felt much more on light or sandy soils than on heavy clay is its improving effect on the soil texture and its water-holding capacity. It is still an open question whether green manuring, by growing the green material in another place and carting it for burial to the field, provides the same benefits, and if it would be as economic as grown *in situ*. But the fact should not be overlooked that under very dry conditions, where irrigation is not available, plant nutrients as well as moisture are *transferred* by this practice. This applies particularly to parts of the country where it is a common practice to grow green manure plants on waste land or on embankments or bunds which cannot be used for the growing of useful crops.

Effect of applying green manures to certain crops

For rice, green manures are beneficial under favourable monsoon rain conditions, or where irrigation is possible.

For sugar cane and wheat they are valuable where burying can be done in time for decomposition to occur and irrigation is available. If used for maize and potatoes the results are also favourable, and it has a good effect on cotton. Other crops can also benefit. Whether the application is worthwhile depends entirely on the economic return of the following crop. Green manuring is widely used in orchards, on coffee and tea plantations, and its effect on coconut plantations is also most beneficial.

Under favourable conditions the quantity of green matter turned under for green manure is rather considerable. On medium soils it may be as much as 20,000 to 25,000 lb. per acre, and 70,000 lb. or more per acre on rich soils. The amount of nitrogen added to the soil in this way ranges from 50 to 75 lb. per acre. The increase in yield of the following crop depends naturally on the success of the green manure crop and the decomposition. Another circumstance to be noted is that the relative increase is generally higher on medium or poor soils than on rich ones. It can be safely stated that an increase in yield of from 30% to 75% has been found on rice, 50% on sugar cane, and 20% to 25% on wheat. The results with cotton are from 10% to 45%. A great deal more research in this matter is needed as the data available are scanty. On the other hand, the fact that conditions vary to a great extent makes generalisation rather difficult.

The residual effect varies considerably, but though the added nitrogen is probably consumed within six months from burial, other nutrients can have a favourable effect up to four years. A further advantage is the betterment of the soil structure, the tilth and water-holding capacity. The effect of green manuring on alkaline soils

needs further research as results differ, but since good response has been obtained in some places this problem should be given careful study, in view of the fact that salination of soils under irrigation as for instance in the Punjab, is a steadily spreading danger.

Another aspect of green manuring is the joint use of green manure and fertilisers. It is an established fact that fertilisers, especially phosphate and potash, have a better effect if applied to the green manure crop instead of the main crop. On the other hand, direct addition of phosphate fertiliser to green manures resulted in better yields than green manure alone. This should apply to rice, maize and oats. Some spectacular results have been obtained with sugar cane by adding sulphate of ammonia to green manure Sunn-hemp. The same success can be registered if castor or rape cake is added, these being widely used as fertilisers in India. It would be of great importance to find out the best way of application, and large-scale experiments would also be needed to prove the residual value of fertilisers applied to green manures.

Economic aspect

The economics of green manuring need more research too, though it has to be kept in mind that general figures can be of little use, having regard to the extreme variations in application and return. It has been proved that the net saving per acre can be quite considerable — as much as from £5 to £10. The application of green manure has sometimes doubled the net profit.

Another aspect of the problem needing further study is whether the use of green manuring plants for dual purposes is economically sound. Experience seems to show that if, for instance, the fibre is extracted from Sunn-hemp and only tops and roots and other waste material are buried, or if the bulk of the green material is cut for fodder and only the residues are turned under, this gives a very reduced manuring effect. Here, too, generalisations are difficult, because Berseem, for instance, can be used successfully both for fodder and for green manure.

A Rhodes grass trial plot at the research station

Conclusion

It can be said that green manuring is, for the time being, one of the best methods of soil improvement in India and Pakistan. Much depends on using the right technique, and therefore, though research should be extended in order to answer a number of yet undecided questions, the ultimate success or failure of green manuring will depend on the farmer. The extension of green manuring will have to be incorporated as an important item into the activities of the newly organised advisory service, and as so much depends upon the individual only very personal approach can bring satisfactory results.

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Pakistani Development Projects

Six project agreements under the 1953 supplementary programme of the Technical Co-operation Administration of the United States were signed in Karachi. Under these agreements T.C.A. will provide 8,437,500 dollars out of a total of 12,254 million dollars provided under the 1953 Supplementary Programme Agreement recently concluded.

A factory with a capacity of 50,000 tons of ammonium sulphate per annum is to be constructed at Mari Indus in the Punjab. The factory will have its own power station and under this agreement this project is to receive 3,000,000 dollars in addition to the 4,000,000 dollars provided under the 1952 Projects Agreement. The sum of 3,700,000 dollars has been made available for the acquisition and distribution of 75,000 tons of fertilisers, with a view to increasing crop yields, additional experimentation on soils and for demonstration to farmers.

The third project envisages the construction of a dam on the Bolan River in Baluchistan, with the purpose of increasing food supplies and providing farm land for the permanent settlement of about 2,500 small cultivators and their families. A sum of 450,000 dollars has been provided for this project, to be spent mainly on equipment, technicians and training facilities.

A modern fish harbour is to be constructed in Karachi, and a sum of 750,000 dollars, which is the estimated dollar cost of the first year's construction, has been allocated for this project.

A village aid scheme is to be undertaken to raise the standard of living of the people of Pakistan by increasing agricultural production, improving health and sanitation and introducing cottage industries to provide part-time employment for the rural population. The immediate plan is to set up eight training centres in the different provinces. Towards this project the U.S.A. has contributed 437,500 dollars in addition to the amount provided last year. A laboratory is to be set up in Karachi to provide research services for all parts of Pakistan. This will include a soil mechanics section for the testing of soil samples and cement concrete, and a hydraulics section for research and experiments in connection with hydro-electric power, irrigation and flood protection schemes. The United States is providing 100,000 dollars for this project.

Spray Nozzles

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The design of spray nozzles is a matter which profoundly affects the efficiency of spraying operations. In this article, the principles involved in nozzle design are discussed and some typical forms described.

NOZZLES may be said to be in one way the most important part of a spraying machine. Every part is equally necessary for the functioning of the whole of course, but in designing machines it is possible to meet more trouble by the choice of unsuitable nozzles than by a mistake in the selection of other components. There is great latitude of choice and a wide range of performance is available. Broadly speaking, one piston pump is much like another from the point of view of storing pressure energy, but nozzles differ greatly. The following is mainly a survey of the field in this regard, with a few indications of the general suitability of nozzles for varying purposes.

Choosing a nozzle

A nozzle is chosen with several criteria in mind. The working pressure to be used is important in determining the type of pump to be used and, for a given nozzle, the degree of atomisation and the range attainable. The range of the spray can be altered within wide limits from a few feet at low pressure and with fine atomisation to 20 or 30 feet using high pressures, coarse atomisation and a narrow concentrated beam of spray.

Throughput is a primary consideration, but except in special nozzles can be varied to suit almost any requirement. Atomisation similarly may be chosen suitably but not independently. It is, of course, extremely important since to a first approximation the mean drop size (surface median diameter) required for adequate cover is directly proportional to the dosage rate in low-volume spraying.

Nozzle 'pattern,' that is where the material is placed by the nozzle, is not readily variable and requires checking empirically for each type of nozzle. Freedom from blocking is important, particularly in view of the advance of ultra low-volume spraying and the consequent increasingly fine atomisation and decreasingly small nozzle orifices. Freedom from corrosion and wear resistance are also important. Finally, price must play its part since there are inevitably wide variations in price for different types of nozzles depending upon their ease of manufacture. It may be at times worthwhile to accept some of the less desirable qualities of a particular nozzle in return for a decrease in first cost, but the annual cost of materials can exceed by far the first cost of the spraying machine and therefore any potential decrease in efficiency of application should be viewed with suspicion.

Nozzle types

There are two classes of nozzles used for agricultural spraying. These are 'two-fluid' nozzles and a nozzle which breaks single drops from the mass by centrifugal force. In the first class, the liquid to be atomised is made to move relative to another fluid—usually air but occasionally hot exhaust gases. Either the liquid or the air may be moving relative to the machine. In the first group are the large numbers of pressure atomisers whereby the liquid is made to move quickly under an imposed pressure. In the second group are included all forms of air-blast atomisers where the high air speed breaks the slowly moving liquid stream to pieces. Intimate contact between the two fluid streams is generally desirable.

The mode of atomisation is thought to be approximately similar in each case and is allied to the theory of the break up of liquid jets, which is as follows. A ligament of fluid is in an unstable condition if its length is greater than its perimeter, and it then tends to break up into uniform lengths, each rolling into two or three drops (one large one and one or two small ones), the size of the drop formed being in proportion to the size of the ligament.

It is impossible to obtain a sufficiently small ligament directly in a pressure nozzle, and accordingly the liquid is forced to form a thin diverging sheet. The liquid velocity in this sheet is approximately constant and therefore the thickness of the sheet must decrease in proportion to the increase in the width. If it is remembered that the function of a pressure nozzle is to form the liquid into a thin film, then the similarities and differences between several nozzles described will be clear. This film breaks up, firstly (at common working pressures), into ligaments at right angles to the direction of the film motion, through the generation of a periodic disturbance of the surface. Separate ligaments in turn break up into drops along their length. The process is not regular, however, and a range of drop sizes is always formed from

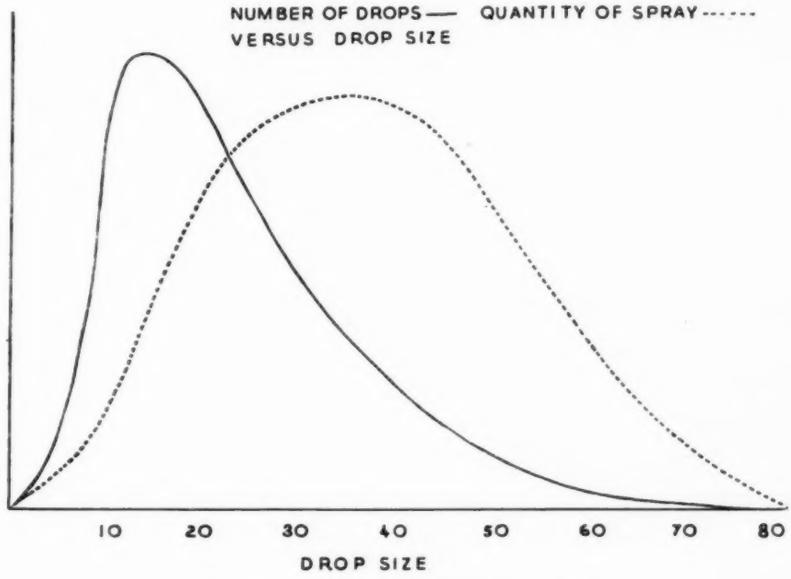


Fig. 1—Graph illustrating drop size

a particular nozzle under one set of operating conditions. The graph relating the drop sizes to their frequency of occurrence is known as the nozzle drop spectrum.

The numerical drop spectrum is, however, not as informative as the volumetric drop spectrum which shows how much of the material sprayed is formed into drops of a given size. This is important because a very small number of large drops may contain a larger amount of spray than a large number of small drops, as the curves of number and volume distribution for an air-blast nozzle show.

It is seen that although drops in the range 8-25 microns predominate numerically, most of the volume of the spray is contained equally in drops in the size range 17-50 microns (Fig. 1).

Drop size is important for the following reasons:

(1) In order to cover effectively an area with a small quantity of material it is necessary for it to be dispersed into small drops.

(2) The behaviour of the drops in the air stream and on reaching the target depends largely upon their size.

(3) The insecticidal activity often depends indirectly upon the drop size.

A drop will cover an area of leaf which is approximately proportional to the square of the drop diameter, if it is small (depending upon the leaf surface and the presence of wetting agents). The volume is proportional to the cube of the diameter and therefore the dosage rate, volume over area (and also the initial thickness of the deposit) is proportional to the drop size. The residual thickness of the deposit, after a given amount of weathering, is likely to tend to a constant value independent of drop size. Therefore, using small volumes, we must use small drops to effect coverage.

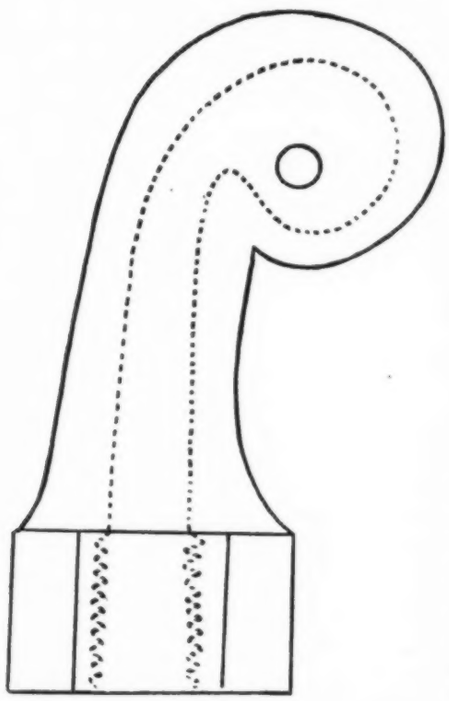


Fig. 2.—An involute type of nozzle. The liquid rotates in a decreasing spiral path until it emerges from the circular orifice

The drops used in small volume spraying are so small that they tend to drift in the wind and it is advisable to minimise this dangerous drift by minimising the proportion of drops small enough to be blown away. Therefore, in general, the task of getting drops to land on the crop requires large drops.

There is evidence also that residual insecticided activity is influenced in varied ways by the drop size and also the particle size of the crystals formed from the drops.

Centrifugal or swirl nozzles

These are at present the most commonly used nozzle. The liquid is introduced into the cylindrical swirl chamber through tangential slots so that it rotates as it progresses. On emergence into the air the rotation causes a centrifugal force which forces the liquid film to spread in a cone. The greater the rotational speed relative to the forward speed the wider the cone angle and the finer the atomisation. With a swirl nozzle it is therefore easy to vary the throughput and atomisation by changing the swirl plates and the relative position and inclination of the entry ports.

For fixed operating conditions a patent involute nozzle is suitable for providing a maximum ratio of rotational to forward speed. The liquid on entering the nozzle moves in a spiral path in decreasing circles until it can finally emerge (Fig. 2).

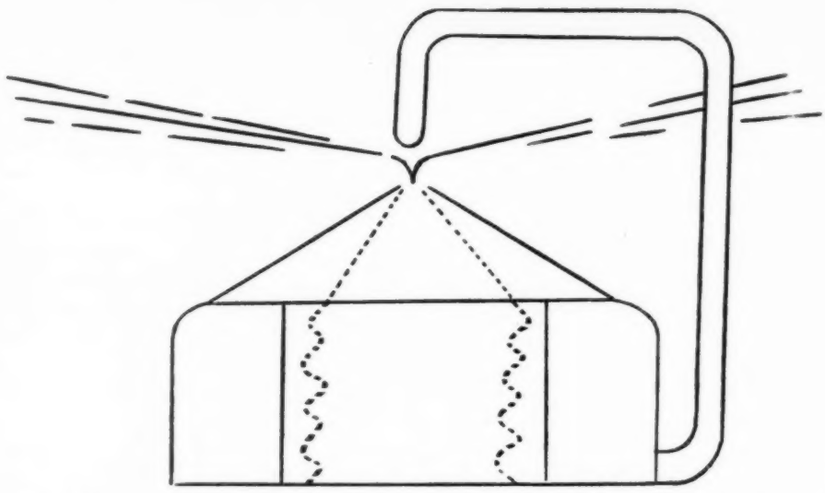


Fig. 3—A Vaspra irrigation nozzle. The liquid strikes the wire anvil and is deflected to form a circular sheet of spray

Anvil nozzles

A swirl nozzle forms the liquid into a conical sheet of the prescribed thickness. Other hydraulic nozzles have the same function of forming the liquid into a sheet. Anvil nozzles provide the cheapest way of doing this.

The liquid is directed in a rod against a shaped solid surface, the anvil, and the liquid streamlines are forced to follow the anvil contours. Accordingly, these may be

Fig. 4—In this type of nozzle, two similar jets are aimed at each other

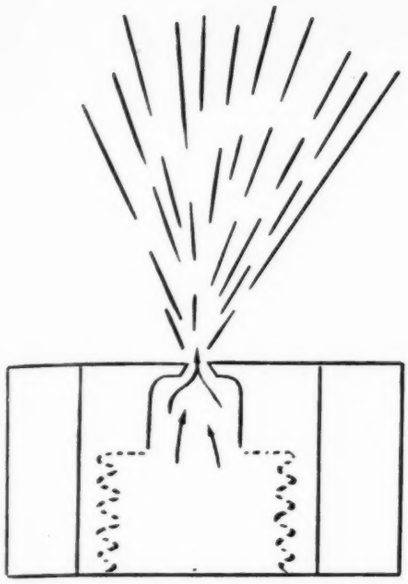


Fig. 5.—In a fan nozzle there is a converging channel with a round-nosed cutter. On the upper side of the nozzle a V slot is cut and a fan is formed parallel to the length of this slot

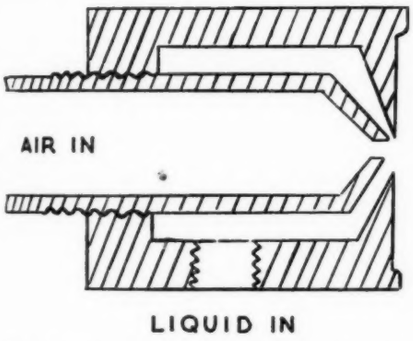


Fig. 6 — In the airblast nozzle, the liquid is introduced into the air stream at right angles to it through a narrow slot

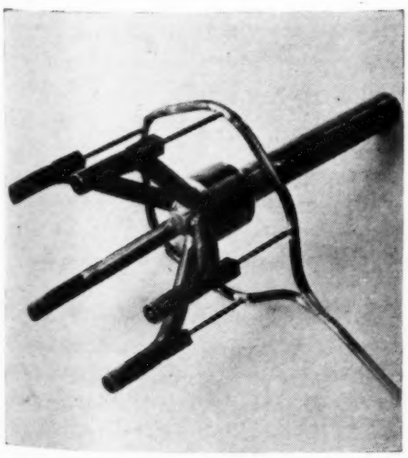


Fig. 7—An airblast nozzle made from stainless steel to give drop sizes approximately 30 microns in diameter

arranged to form a sheet of any required pattern. A Vaspra irrigation nozzle is an example of an anvil nozzle (Fig. 3).

Impinging jet nozzles

Similarly, the ' Anvil ' can be an opposing liquid jet.

Two similar jets are aimed at each other and therefore their velocity is transformed into momentum at right angles to their original direction of approach and a thin film may be formed again. Accurate alignment of the jets is required. This type (Fig. 4) has found its principle application in nozzles for fire fighting and has not been used extensively for agricultural spraying.

Fan nozzles

Fan nozzles may be regarded as a development of impinging jet nozzles where the two jets are contained within one vessel. The convergence of the final channel in the nozzle disc gives rise to two high-speed jets of liquid moving towards each other and the formation of a film of liquid at right angles to the direction of convergence. Such fan nozzles are cheap and efficient. They are cut from incorrodible metal or moulded from a hardwearing and accurately formed ceramic material. Most low-volume weed sprayers are equipped with this type of nozzle (Fig. 5).

In all hydraulic nozzles the break up of the liquid film is caused by the relative motion between the liquid and the surrounding atmosphere. The contrary situation when the air is moving past the stationary liquid quite certainly results in atomisation through the air tearing pieces from the liquid and also by breaking up large pieces torn off from the main stream.

Airblast nozzles

Airblast nozzles assume only one of two general forms. Either the air and liquid are caused to mingle directly or alternatively the liquid is either partially atomised or forced into the form of a film before it meets the air stream. Experiments have shown how important it is to cause intimate mixing between the air and liquid and how easy it is for a low velocity air film to become interposed between the two fluids and hinder break up.

Therefore, whenever it is feasible, the liquid is introduced into the air stream at right angles to it through a narrow slot (Figs. 6 and 7). When this cannot be done—if it is necessary to avoid an obstructing slit orifice—the process becomes far less efficient because the liquid at the centre of the jet is protected by the surface layers of liquid and is not broken up so finely.

Fig. 8 — A Microsol power-driven spinning disc atomiser

A common and useful combination of nozzles is an anvil nozzle to form a liquid sheet and the main break up to be caused by a high-speed air stream. This appears to be the mode of operation of the air-blast nozzle of the Whirlwind Mistblower. Alternatively, an ordinary hydraulic nozzle may be used, spraying in the opposite direction to the air stream as in the Midox mist sprayer.

Spinning disc nozzles

Under certain operating conditions spinning disc nozzles behave very precisely, giving drops of only one size. There are, however, few, other than experimental, occasions when a spray composed of equal sized drops is necessary.

Drop sizes

On the other hand, the range of drop sizes formed from a hydraulic nozzle is very wide and it is often desirable to limit their spread. The smallest drops are both useless and dangerous since they may land several yards away from where spraying is in progress, while large drops are also wasteful of material and dangerous because they may cause damage to the crop through local overdosing.

One solution is filtering off the unwanted large drops from the spray. This is done by interposing a baffle of suitable form in an air stream carrying the spray. Small drops move with the air round the obstacle. Large ones strike anything in their path and drip into the tank to be resprayed. Domestic and dairy fly control sprays employ this principle so that all drops larger than 20 microns are returned to the reservoir. The issuing spray is so fine and sparse as to be invisible to the eye.

A second, and more expensive, method of forming very small drops involves spray-

ng through an air-blast nozzle a solution of the insecticide in a volatile solvent. The solvent evaporates from the drops formed, leaving a smaller drop of non-volatile insecticide. The relative sizes of parent and daughter drop depend upon the concentration of insecticide in the solvent.

Finally, if it can be proved that a uniform small drop size is very useful and important, a spinning disc nozzle may be used. This consists of a metal disc spinning at a high speed on to which the liquid is fed. The fluid is caused to rotate at a speed approaching the disc speed and the resulting centrifugal force flings it from the edge.

If small quantities of liquid are used, separate drops almost all of the same size are formed, in as much as the centrifugal force detaching the drop is equal to the surface tension force holding the drop on. If liquid is added more quickly streams of liquid fly from the disc edge and break up more or less regularly. Still greater quantities of liquid form a sheet parallel to the disc which breaks up in approximately the same way as the sheet of liquid from a flat nozzle.

Therefore, the advantage of a spinning disc nozzle in giving drops of only one size is applicable only to a limited range of small throughputs. Commercial nozzles of this form are therefore designed with two objects. Firstly, the discs are so arranged that the liquid is forced to rotate at full disc speed, while attempts are also made to increase the throughput without loss of drop size homogeneity. Of course, the discs are expensive and their high rotational speed is a disadvantage precluding their use except in exceptional circumstances (Figs. 8 and 9).

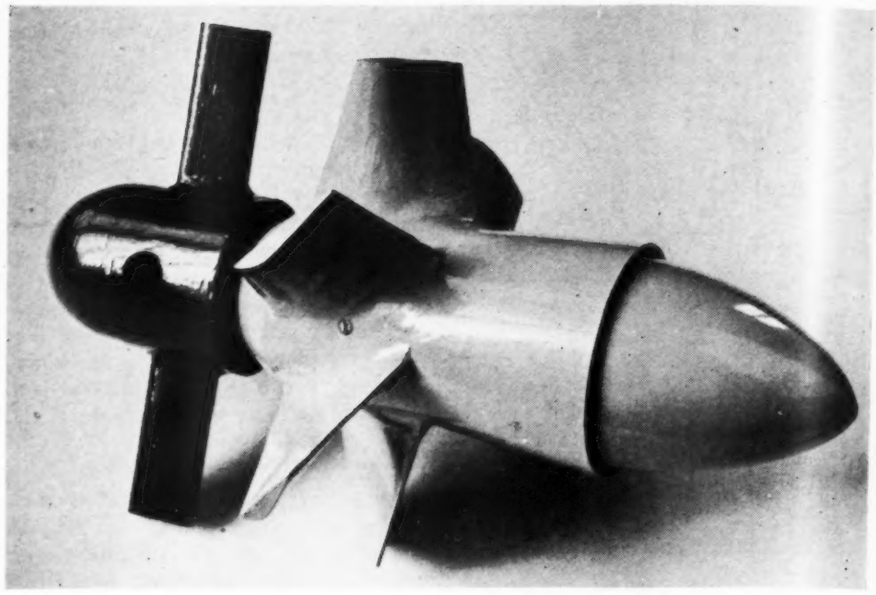


Fig. 9—A Micron air-driven spinning cup atomiser

Conclusion

This survey is the result of studies of the work of many people. It is hoped that it shows how widely this important part of a spraying machine may vary; it is also hoped that later it may become possible to indicate the suitability of particular types for particular purposes.

There are two practical problems which are as yet without solution. It is not possible to obtain cheaply and efficiently either (*a*) very small drops, or (*b*) drops of roughly equal size of solutions and of solids in liquid suspensions.

Plastics in Agriculture

As in other walks of life plastics are claiming an increasing share of attention in agriculture. Imperial Chemical Industries have recently drawn attention to two plastic products for which they suggest there is abundant scope. These are *Perspex*, a material used to replace glass for windows and similar purposes, and *Alkathene* which is now produced in the form of light-weight flexible tubing.

Perspex

'Perspex,' a clear transparent material, is now being produced in corrugated form and Imperial Chemical Industries suggest that it provides an economic and efficient way of bringing more daylight into a building with a corrugated roof, *e.g.*, cowsheds, piggeries, workshops. They go on to say that for use in tropical and semi-tropical countries trials have shown that an opal form of 'Perspex' which has been produced is recommended, because it scatters the direct rays of the sun. Profiles are available to match most standard asbestos cement and metal corrugated roof sheeting, while corrugated 'Perspex' sheets are easily fixed in the same way as standard sheets, using hook-bolts and flexible washers.

Corrugated 'Perspex' is stated to be very light in weight—0.9 lb. per sq. ft., compared with 3.6 lb. per sq. ft. for $\frac{1}{4}$ in. wired glass. Unlike glass, corrugated 'Perspex' requires no extra supporting steelwork, glazing bars or lead flashing, and can be fixed by unskilled workers. Installation costs are therefore very low.

Alkathene

'Alkathene' tubing is a new, light-weight, non-metallic piping constructed of plastic, and is especially suitable for conveying cold water. It has great advantages over metal piping for water distribution lines in farmhouses and outbuildings. It possesses remarkable properties of resistance to air, water and soil corrosion. It is an excellent thermal insulator, and water carried in 'Alkathene' tubing is much less likely to freeze than when carried in metal piping. The tube will withstand pressures equivalent to water heads of up to 1,500 ft.; it is 11 times lighter than lead and flexible enough to be coiled for carrying and storage. It is far easier to manipulate and can be cut with a knife, saw or pipe-cutter, and can be jointed by normal screw couplings or compression joints or by butt-welding. It is available in lengths up to 500 ft. Two types of tube are available—heavy gauge in $\frac{1}{4}$ in., $\frac{1}{2}$ in., $\frac{3}{4}$ in. and 1 in. bore, and standard gauge in $\frac{1}{2}$ in., $\frac{3}{4}$ in. 1 in. and $1\frac{1}{2}$ in. bore.

A tube which is not corroded by soil, water or atmosphere, possesses remarkable resistance to frost, and is light enough to be carried from place to place is obviously of great value to farmers and market gardeners. Particulars can be obtained from Imperial Chemical Industries, Export Division, Welwyn Garden City, Herts., England.

The Queensland Cotton Crop

L. T. SARDONE

Cotton has been grown in Queensland for many years, the area cultivated and the amount produced having shown great variations owing to various causes. The history and the present position of the industry are reviewed below.

COTTON growing has been associated with the development of Queensland since the earliest days of Australian colonisation. The first settlers to come to Queensland more than 90 years ago introduced the cotton plant, and cotton was grown in the vicinity of the capital city of Brisbane during the pioneer agricultural settlement of this State. As settlement expanded and extended to the westward of Brisbane, the cotton-growing industry played an important part in the pioneer development of the virgin country in the Moreton, Fassifern, Lockyer and Brisbane Valley districts. Cotton was for many years the principal agricultural crop produced, and was associated with the successful early settlement of these lands.

History of the crop

In 1871, 15,000 acres of cotton were grown in the Moreton and Lockyer districts. In later years, however, after 1880, the industry declined and went out of existence. The principal reason for this decline was that the whole of the production of raw cotton in Queensland had, in those early days, to be exported to Great Britain; the low prices ruling for cotton in overseas markets at that time, and the heavy transportation and shipping charges acted as a deterrent to the expansion of cotton growing in Queensland.

However, the industry was revived in 1920, when the Queensland Government gave a guaranteed price of 5½d. per lb. for seed cotton delivered on rail for a period of five years. By 1925, annual production had increased from nil to 12,000 bales of raw cotton. From 1926 onwards, assistance to the cotton-growing industry came in the form of a bounty granted by the Commonwealth Government of Australia. Maximum production, 17,500 bales of raw cotton, was reached in 1934. During the war years cotton production once more declined by reason of acute labour shortages in rural areas and the necessity for greatly increased food production.

Cultivated areas

At present, cotton is principally grown in an area extending from the New South Wales border to just north of Rockhampton and inland from the coast up to a distance of approximately 150 miles. The main growing areas are the Callide and Dawson Valleys in the Central District of Queensland, the Upper Central and South Burnett Districts, and the Lockyer and West Moreton Districts in South-eastern Queensland. Cotton is also grown commercially on the Northern Darling Downs and in parts of the Maranoa District.

Practically all Queensland cotton is grown in the country westward of the coastal range, and whilst cotton can be grown successfully in the coastal belt, the fact that no killing frosts are experienced there is a factor against the successful growing of crops in that area. In the main cotton-growing areas westward of the coastal range good killing frosts are experienced during the winter months. This is necessary and advantageous for the growing of cotton and is also an important factor in the control of insect pests.

Cotton plant with mature bolls at the bottom and flowers of middle crop

Growing conditions

Up to the present practically all Queensland cotton has been grown under dry farming conditions, but projects are now in hand for the development of water conservation and irrigation. It is expected that in the future a great proportion of the crop will be grown under irrigation. Experience indicates that when the crop is grown under irrigation the average yield can be increased from two to threefold compared with crops grown under dry farming conditions.

Practically all commercial cotton today is grown in areas where killing frosts are experienced during the winter months, very little being grown in frostless areas. The cotton plant requires about seven to

Spraying a young cotton crop

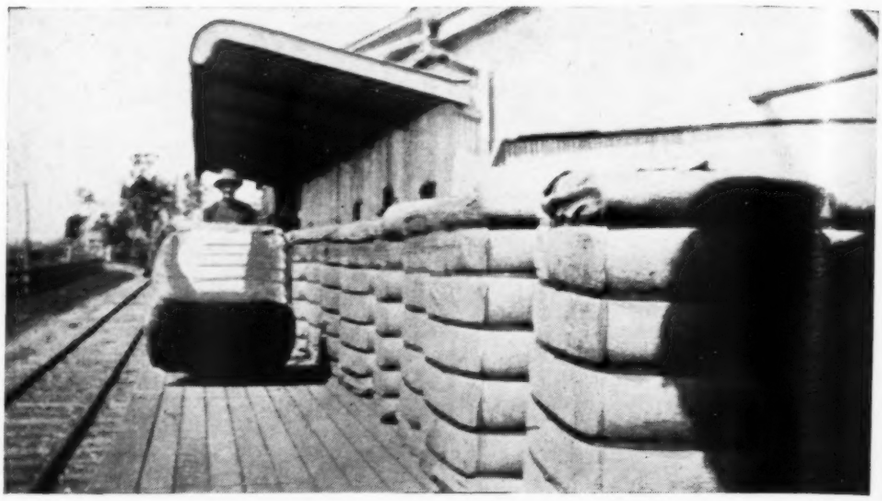
eight months of a growing season free from frosts for its full development.

Cultivation

The crop is planted annually and requires from 15 to 20 lb. of seed per acre. The seed is planted in drills approximately 4 ft. apart, and sufficient is sown to give a continuous row of young seedlings. When the plants are about 6 in. high they are thinned out so that single plants remain in the rows from 12 to 15 in. apart.

Good cultivation is necessary to control weed growth and to retain a mulch on the surface of the ground to prevent loss of moisture and to aerate the soil. Normally about three to four cultivations are necessary to bring a crop to maturity. About ten weeks after germination the plant commences to flower. Flowering continues over a period of some 100 days, the flowers being set in well-defined flushes. A period of from seven to eight weeks elapses from the appearance of a flower until the cotton boll is fully matured and open. As the flowering period extends over three months, the maturing of the bolls extends over the same time, entailing from one to three separate pickings during harvest.

In Queensland, cotton is planted from September until November, whilst harvesting commences in March and continues until the end of August. Owing to Queensland's dry, sunny winter, her crops produce a high grade of cotton. Favourable climatic conditions during harvest make for well-matured cotton of a high grade, conditions which can generally be classed as ideal. Generally, 70% is harvested during April, May and June, and, up to 1939, had virtually all been hand-picked, some 2,000 to 3,000 workers being engaged.



Raw cotton in 500-lb. bales ready to be taken by rail to the ginnery

Mechanical picking

Twelve American mechanical cotton pickers are now in operation. It has been found that where the crop is suitable for mechanical picking, and other conditions are favourable, a machine will harvest from 85% to 95% of the open cotton on the plants. The ideal crop for mechanical harvesting is a single-stalk cotton plant having short fruiting branches growing from its main stem. In addition, the ground must be free of stones, sticks, trash and weeds. Defoliating has now been introduced in conjunction with mechanical picking, plants being dusted with calcium cyanamid dust which has the effect of causing the leaves to dry up and fall from the plant, leaving no green leaves to be harvested with the cotton.

Spindle type mechanical harvester in operation

Varieties

It has always been the policy of the Queensland Cotton Marketing Board to keep the number of commercial varieties grown as small as possible. This facilitates ginning, reduces handling costs, and also the cost of distributing seed for planting. It is also important in that it results in the production of a more uniform grade of raw cotton; this is of considerable advantage to the cotton spinner when processing takes place in Australian cotton mills.

At present, varieties have been reduced to four, and it is considered that this number is ample to provide for the different soil and climatic conditions existing in the rather extensive cotton-growing belt.

Taking 1946 as a typical season, the production of cotton of each of these four varieties in that year was:

Variety	*Bales of Raw Cotton Produced*	*Percentage of Crop*
Miller	1,186	50
Mexican Acala ..	854	36
Triumph	166	7
Lone Star ..	94	4
Sundry	72	3
	2,372	100

Miller has been one of the most outstanding varieties grown since the industry's revival in 1920, producing a hard bodied, good picking cotton with a low percentage of immature fibre and a 1 in. staple, which is in good demand by Australian spinners.

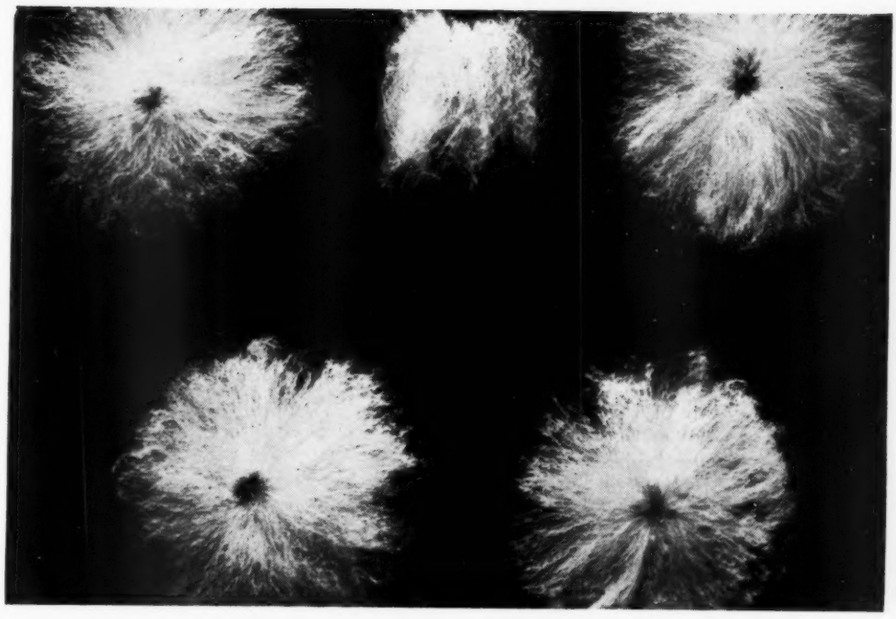
Mexican Acala was developed under irrigation in the United States and, under good soil and rainfall conditions produces a high quality cotton with a staple length

of 1 1/16 in. Under irrigation in Queensland this variety has produced very well, and the quality has been of a high standard.

Triumph produces a shorter staple cotton ranging from 15/16 in. to 1 in. This variety, however, is quick maturing and will set a profitable crop more quickly than the others. This is particularly important when a crop has to be planted late owing to delayed spring rains in the early part of the season. There is a good demand by Australian spinners for a 15/16 in. staple cotton, which Triumph can well take care of, provided its production is kept within a certain percentage to provide the requirements of spinners for this class of staple length.

Lone Star has been improved during the last 20 years in Queensland by the Department of Agriculture, and will produce 15/16 in. and 1 in. raw cotton of good quality. It has produced well on certain types of soil, particularly in the Burnett district.

All Queensland varieties were originally imported from the United States; the Department of Agriculture, over the past few years, has been testing out a number of new importations from the U.S.A., most of which belong to a type similar to Miller. Among them, the Rowden and Qualla varieties are outstanding.



Various cotton fibres

Grading and ginning

When seed cotton has been harvested, it is packed into 400 lb. to 500 lb. bales and consigned by rail to the nearest ginnery. Upon arrival here the seed cotton is graded by departmental experts, when grade and staple length of fibre are determined. On this basis the grower is paid for the quality of cotton he consigned to the Board. Bales are then carefully weighed, and each placed in the receiving shed according to variety, grade and staple length; these never being mixed in the ginning process.

The ginning process consists simply of the separation of fibre from seed. Harvested seed cotton contains roughly by weight one-third fibre and two-thirds seed. After the bales have been opened, the cotton is drawn into a pipe by air stream and carried through a series of cotton cleaning machines. These machines remove the leaf, trash and dirt from the seed cotton prior to actual ginning.

Three ginneries are in operation—at Brisbane, Gladstone and Rockhampton. Each contains ten ginning stands, each stand comprising a gin of 80 saws, which revolving rapidly separate the lint from the seed.

The raw cotton is automatically deposited in the baling press box, and when the requisite weight of 500 lb. is reached it is pressed up to its finished size by a hydraulic ram which moves up inside the box, reducing the size of the finished bale to about 4 ft. by 4 ft. by 2 ft. The bale is then wired and branded with serial number and ginnery name. Bales are usually held for 48 hours to ensure that no fire hazard exists, then shipped to spinning mills in the capital cities of Brisbane, Sydney, Adelaide and Melbourne.

View of the ginnery interior, showing the mass of raw cotton

Cotton seed processing

Of the total amount of cotton seed produced from a crop, 300 lb. per acre under dry farming and 800 lb. per acre under irrigation, only 2% to 5% is required for planting purposes. The surplus is available for processing in the oil mill, owned and operated by the Cotton Marketing Board at Whinstanes, Brisbane. This mill is capable of treating 6,000 short tons of seed on a one-shift basis, 12,000 short tons on a two-shift. The board is the biggest producer of edible oil in Australia, and the whole of its production finds a ready market in the Commonwealth.

Marketing

The Queensland cotton crop is handled and marketed by the Cotton Marketing Board, a co-operative organisation representing the growers, by whom it is controlled. The board operates under State legislation known as the Primary Pro-

ducers' Organisation and Marketing Act. It consists of six cotton growers' representatives elected every three years, together with one additional member appointed by the State Government, representing the Minister for Agriculture.

The board takes delivery of all seed cotton on rail at the grower's railway station, gins it, and markets the raw cotton lint direct to cotton spinners and other manufacturers in Australia. In addition, it processes all the surplus cotton seed for the extraction of cotton seed oil and the manufacture of a high protein cotton seed meal and cotton linters. All these products are marketed directly by the board, the whole of the net proceeds from these operations being returned to the growers. In pre-war years the gross annual turnover of the board was between £A400,000 and £A500,000.

Future prospects

Raw cotton is the principal textile fibre used for the manufacture of clothing, while cotton represents about 56% of the total world production of all textile fibres. Scoured wool accounts for only about 7%, rayon and synthetic fibres for about 10%, while the remaining 27% is made up of flax, jute and hemp.

Fifty years ago raw cotton was used almost exclusively for the manufacture of clothing material, but a recent survey in the United States shows that in that country at present 38% of the total consumption of raw cotton is used for the manufacture of wearing apparel, 25% for household uses, and 37% for industrial purposes. The largest single user of raw cotton in America today is the motor tyre industry, raw cotton being an integral part of the tyre fabric.

Australia, owing to its climatic conditions, probably uses more raw cotton per head than any other country in the world. It is estimated that the present equivalent total consumption of raw cotton in Australia per year is from 300,000 to 350,000 500-lb. bales, *i.e.*, 100,000 bales used by the cotton mills and 200,000 to 250,000 bales imported into Australia in the form of manufactured goods.

Prior to the last war, Queensland, the only Australian State growing cotton, produced about 13,000 bales of raw cotton, so it can be seen that there is tremendous scope for the development of cotton growing and cotton manufacture to meet the requirements of the Australian people. The industry has now been guaranteed a price of 14d. per lb. of seed cotton grown during the 1953 and 1954 seasons, and it is hoped that this will lead to increased production.

The Queensland Government has set a target of 60,000 acres of cotton during the next five years, but at the moment there is no definite plan to back this, and the aims and policy of the Agricultural Council in this regard, as stated recently by the Minister for Commerce and Industry a year ago, must be implemented if this target is to be reached.

At present some difficulty is being experienced in marketing Queensland cotton owing to the low prices for imported raw cotton, and the fact that the cost of production in Queensland is much higher than in the cheap labour countries. It follows that if the Queensland cotton industry is to show expansion, some form of fiscal protection for the industry may be necessary.

APPENDIX

QUEENSLAND COTTON PRODUCTION, 1927 TO 1952

Season	*No. of Growers*	*Acreage Planted*	*Seed Cotton Produced (lb.)*	*Lint Percentage Seed Cotton*	*Raw Cotton Produced (lb.)*	*Raw Cotton Bales*
1927 ..	2,080	20,100	7,054,951	32.759	2,311,171	4,824
1928 ..	2,400	24,970	12,221,598	33.636	4,110,602	8,268
1929 ..	2,278	22,000	7,965,339	31.616	2,518,348	5,044
1930 ..	2,241	32,781	17,006,460	32.928	5,599,400	11,051
1931 ..	2,859	39,768	15,147,553	32.289	4,890,953	9,689
1932 ..	3,816	61,304	6,171,254	32.279	1,990,138	3,989
1933 ..	3,733	74,610	17,718,306	31.387	5,561,338	10,974
1934 ..	3,202	49,283	26,861,635	32.647	8,769,510	17,471
1935 ..	3,195	57,017	20,766,209	34.007	7,061,749	14,515
1936 ..	3,364	62,514	19,198,600	34.658	6,653,973	13,504
1937 ..	2,889	55,133	11,792,828	34.882	4,113,684	8,519
1938 ..	3,657	65,796	13,687,872	34.887	4,773,936	9,654
1939 ..	2,409	41,112	17,527,709	35.274	6,182,808	12,447
1940 ..	2,143	41,530	12,108,491	34.091	4,127,823	8,370
1941 ..	3,527	57,507	15,869,159	35.486	5,631,374	11,437
1942 ..	3,808	50,485	14,057,690	35.033	4,924,816	9,962
1943 ..	3,720	39,875	9,539,697	35.071	3,345,622	6,814
1944 ..	1,698	17,120	8,515,581	34.601	2,946,478	6,055
1945 ..	646	7,099	1,820,246	35.750	650,749	1,305
1946 ..	688	6,644	3,202,161	35.561	1,138,734	2,372
1947 ..	745	8,973	2,197,709	34.673	762,010	1,531
1948 ..	680	6,688	2,069,740	34.445	712,920	1,439
1949 ..	263	2,232	736,883	34.56	254,668	522
1950 ..	276	2,532	1,106,919	36.342	402,279	806
1951 ..	453	3,594	1,493,595	36.775	549,272	1,124
1952 ..	461	5,397	2,156,018	35.009	754,818	1,483

A Swedish Rolling Refrigerator Plant

Constructed to deal with gluts of agricultural products, berries, fish, etc., as they may occur in any part of the country and with the idea of facilitating the supply of fresh or perishable food to faraway places, a new train refrigerator plant has recently been put into service by the Swedish State Railways. Known as the Thermo Train, this innovation in Swedish transport was first put to use to help cope with the strawberry harvest at Finnerödja, at the end of July, 1951. In this district 2 million kilos of strawberries have usually to be dealt with in two or three weeks.

The idea of constructing this new type refrigeration plant was put forward by Mr. Tore Lauritzon, director of the Helsingbors Cold Storage Co., and was quickly adopted by the State Railways. At a cost of about £35,000, the complete train was built in collaboration by the State Railways, the Helsingbors Cold Storage Co., and the STAL freezing plant specialists. Consisting of one machinery wagon, two refrigerator wagons and a fuel and materials van, the new plant is an entirely self-contained unit.

In the machinery wagon the STAL freezing equipment, which includes a 9-cylinder low-pressure compressor and a 3-cylinder high-pressure compressor, cools the air down to —35° C. (—31° F.). At this temperature the air is conducted by an SF ventilator fan with a capacity of 50,000 m³ (1,765,000 cu. ft.) per hr. to the refrigerator car where it can freeze 400 kgs. (882 lb.) of products per hr., or 10 tons per day. Power is supplied by a Scania-Vabis 8-cylinder diesel engine. Ammonia is the freezing medium.

The temperature in the refrigerator car can be maintained at —30° C. through 24 hours with a normal outside temperature of +20° C. (68° F.). This is achieved by good insulation, the roof, floor and walls having a thickness of about 10 in. and being insulated with Swedish Isotlet foils and by the use of eutectic plates.

The loading capacity of each of the refrigeration wagons is 11.5 tons.

Recent Agricultural Developments in Iraq

(From an Agricultural Correspondent in Iraq)

TODAY, Iraq is one of the less developed regions of the world. In ancient days it was one of the most fertile and highly developed parts, but it was brought to ruin by the invasion of the Mongolian hordes in the 13th century and has never recovered its former productivity. Recently, developments in the oil industry have enabled plans for rehabilitation to be undertaken by the Iraqi Government.

At Haweijah, in the Kurdistan section, an outstanding project in land settlement is getting under way. Some 330 families from two tribes of nomadic shepherds are being settled on 24,000 donums (donum = approx. one-third of an acre) of flow-irrigated land. The 'average' family is about five in number—often one male and four females; each family is allotted 70 donums of land, free in the first instance although after three years they may be expected to make some annual payment to the Government. The plan envisages extension of the settlement in this area to three times the present size.

The scheme is supervised by a staff of resident administrators and instructors, while in supreme charge is a project director. The work of the administrative staff includes instructing the cultivators in cultivation methods and the use of implements, ensuring that tenants follow and adhere to the approved cropping programmes, raising planting material and livestock for distribution to the tenantry, and regulating and supervising the supply and distribution of irrigation water.

Government plant-raising house at Haweiga. Seedlings are given to settlers

Irrigation and drainage control

The supply and control of irrigation water and control of drainage is of prime importance to the scheme. The following is a brief description of the layout in this regard.

The scheme is based upon the Haweija Barrage constructed on the River Zab, a tributary of the Tigris, which controls the flood water of the river and stores water for irrigation. The water from this is led down by main supply channels and distributed by minor irrigation channels. The latter are spaced 25 metres apart and provide water runs 50 metres in length. Practically all irrigation channels, both minor and main, have been dug by hand.

Cropping systems

There is both summer and winter cropping, and there is also a certain proportion of the land which is given up to permanent orchard crops; in arable cropping half the land is fallowed annually. The main winter crops are wheat and barley, wheat predominating in the proportion of 17 donums to 11 donums annually on a 70-donum holding.

Summer crops usually comprise mainly cotton and sesame in equal proportions, together with about an equal area of summer vegetables.

Wheat and barley occupy the land from January to June on areas that have been previously winter ploughed. Ploughing is done with the primitive wooden nail ploughs using one or two mules; several ploughings are given but the operation only touches the surface layer and is very inefficient. Seed is sown broadcast and covered by a further ploughing; this, with the hand-made water channels, leaves the land very rough for harvesting with the combine harvester, which is slowly coming into use.

Both wheat and barley are given four or five waterings during the growing season; wheat yields average 250 to 300 kilos per donum and barley somewhat higher. Summer crops need more frequent irrigations; yields of sesame average about 50 kilos per donum, while cotton may give up to 400 kilos per donum.

As stated above, orchard crops may be grown on part of the holding under irrigation; these may include dates, olives, figs, plums, peaches, apples and apricots. They are planted in rows ranging from 2 to 8 metres apart and intercalary crops of vegetables are grown. Fertilisers are only given to orchard crops.

Animals are mainly used for cultivation and the number available is small. Tractors are only employed on a small scale and the economy of the project could be considerably improved if tractor cultivation could be introduced on some scale, especially as this would allow the production of larger numbers of productive livestock, *e.g.*, sheep for wool.

It is hoped that the Haweija settlement

A roadside example of erosion

may become something of a model for other peasant settlements in Iraq and may lead to improvement in Iraqui agricultural methods.

Other development projects

A programme of essential water control developments for the whole country has been worked out under a mission sponsored by the International Bank. It includes proposals for the erection of five dams and reservoirs and for barrages on both the Tigris and the Euphrates and their tributaries, as well as the restoration and improvement of some existing irrigation systems and their distributaries.

It is envisaged that ultimately under this programme 15 million donums of cultivable land should be made available for occupation by 5 million Iraqis, which includes some 4 million donums of Government-owned land not at present utilised.

Already the Dujaila settlement in South Central Iraq, carried out between 1945 and 1950, has resulted in the resettlement of 1,058 peasant farmers on holdings averaging 100 donums each. These people were formerly share cropping tenants under the local sheiks, and they are now emerging from what formerly amounted to a condition of serfdom and developing into independent peasant farmers.

With mechanisation in date gardens, hand digging for weed control has been eliminated

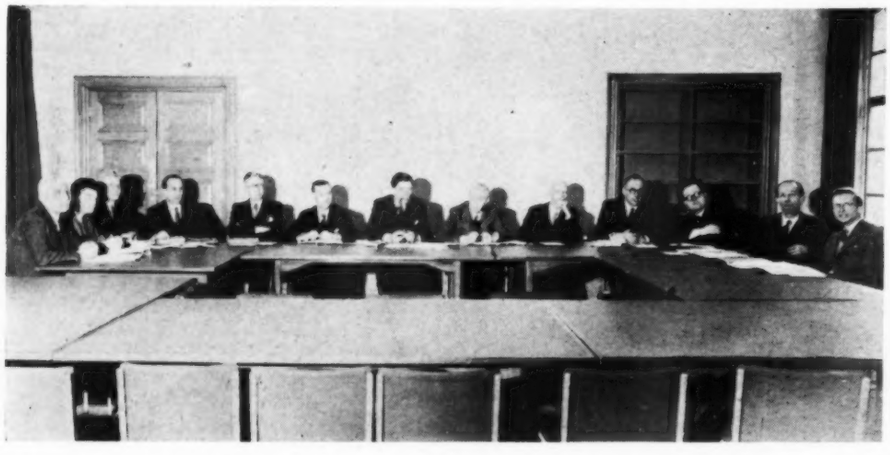
Conclusion

These developments are of considerable importance and will, it is hoped, eventually improve the standard of production in a country where it was previously deplorably low. There is, of course, a lack of trained operatives, such as tractor drivers and other similar types, but the progress that has already been made suggests that, given instructional facilities, the average and above average Iraqi countryman could acquire the necessary skills without undue effort.

The British Crop Protection Products Approval Scheme

Started in 1942 and responsible for setting a high standard for insecticides, fungicides and weedkillers, the Crop Protection Products Approval Scheme is now in its eleventh year. Under the chairmanship of Prof. J. W. Munro, C.B.E., the advisory committee meets regularly to approve new products and their labels. The latest Approved List, which is available free of charge on application to the Ministry of Agriculture and Fisheries, contains approximately 380 products and has just been published by the Ministry of Agriculture which, in consultation with the Association of British Insecticide Manufacturers, is responsible for the running of the scheme.

In the 1953 Approved List several new groups have been opened. BHC and DDT smokes which control a wide range of greenhouse pests are now considered to have been sufficiently tested to warrant inclusion. Carrot and parsnip growers and foresters will be glad to see certain selective oil herbicides are now approved. Here the committee had to face the difficulty that oils drawn from different oilfields differ in their selectivity and phytotoxicity, *i.e.*, their ability to kill weeds and not carrots. It is perhaps relevant to mention that where an excessive volume of oil is used per acre a lowering in yield of carrots will take place. In forest seedling nurseries selective oils have in certain cases reduced the cost of weed control to a tenth.



A meeting of the advisory committee of the Crop Protection Products Approved Scheme in progress. Members of this committee are impartial scientists drawn from leading research stations

A new group of dry seed dressings have also been included. Thiram, formerly known as TMTD or tetramethyl thiuram disulphide, to give it its full chemical name, is a valuable non-toxic seed dressing for use on early sown peas and beans, while maize, sugar beet, mangolds, lettuce, spinach and brassicae also benefit. Fruit growers will be interested to see that at last official approval has been given to organo-mercury as an alternative to lime sulphur for apple and pear scab.

Artificial Grass Drying in the Netherlands

J. GRINDROD

Artificial grass drying has made considerable strides in the Netherlands of late years. The present position is described and discussed below.

ALTHOUGH the fertility of the soil of the Netherlands and the excellent quality of her natural pasture are conducive to the development of rational cattle farming, this would never have reached its pre-war proportions without the importation of at least 2 million tons of protein feeding-stuffs a year. As it was, many farms, particularly the smaller ones, maintained herds of remarkable size in relation to their acres.

The background

When, however, as a result of the war, it became necessary to replace imported feeding-stuffs with home-grown produce, the Netherlands farmers turned to grass, their most useful crop, to see them through. Indeed, the need for a substitute for imported feeding-stuffs proved to be no mere wartime need and the rationing of imported concentrates has lasted many years since the end of the war. For the winter 1952-53 the ration of concentrates allotted to each milking cow in Holland amounted to only 275 lb. The price of this works out at about £3 16s. a ton. Consequently, the grass-drying plants which began to operate in the early days of the war have not only added to their number, year by year, but have greatly increased their output.

Most of the drying plants have been established on a co-operative basis; the State, in sympathy with plans to reduce the need for concentrates, strongly supported the use of dried grass, and this was helpful in overcoming many initial difficulties.

Development of grass drying

Although artificial grass drying is still rather a costly business, due, among other things, to the greatly increased price of fuel and much higher wages, the interest of Dutch farmers in this method of preserving their grass is still widening. From a total number of 32 grass-drying plants operating in the Netherlands in 1951 the output was 26,064 tons, compared with 13,697 tons from 26 drying plants in 1949. Although such factors as grass growth and moisture content of the grass affect the output of a dryer, it is worth noting that the quantity of dried product increased from 360 lb. per machine hour in 1949 to 580 lb. in 1951.

To promote the interests of grass-drying plants in Holland a special association has been formed incorporating 39 local societies in various parts of the country. Some 100,000 tons of grass were treated in 1951 by plants affiliated to the central association from which 24,400 tons of dried products were obtained. This represents an average return of 24.5% of dried grass from the fresh product.

Quality of the products

The average moisture content of the dried product amounted to 8.7%, though it varied among the different plants between 6.4% and 13%.

The protein content of grass also varies considerably with the time of the year at which it is harvested. Grass mown in the spring contains a high percentage, usually over 22% of protein, compared with the later cuts. Of 7,113 samples examined, 17.8% contained a protein content of more than 22%, while only 7.9% contained less than 16%. Yearly averages varied between 15.3% and 20.6% for the different plants, while the yearly average for the country was 19.4%. Regarded by the Dutch as highly important to the permanent success of grass drying is the achieving of a high albumen content of the dried grass. This, together with its high carotene content, they feel, would place it in a position comparable in food value with imported concentrates.

Cost of production

As well as the quality of the product, its cost of production is a factor which must be closely watched. This can be controlled to a considerable extent by the judicious working of the plant so that, instead of operating the dryer intensively for a short season only with spasmodic deliveries at other times, the grass supply is spread more uniformly over the whole of the drying period. By this means the maximum number of net drying hours can be utilised. Among the Dutch plants the number of net drying hours operated varied between 39.4% and 93.1% of the number of hours available in 1951. In one case 26% of the available hours could not be worked because of shortage of grass. In another case, on the other hand, this was as low as 1.8%. Although this factor is affected by weather conditions, etc., the efficient organisation of the plant also plays some part.

The larger of the Dutch plants seem to have been more efficient in their use of heat. Water evaporation per unit of coke or oil in these reached a proportion of 1 to 10, compared with a range between 1 to 4.9 and 1. to 11.05 for the whole.

The cost of drying has risen considerably over the 1940-51 period. Whereas the cost of producing 220 lb. of dried grass in 1940 was, on an average, 12s., in 1951 it was in the region of 26s. The latter figure, however, includes depreciation of buildings, and machinery, whereas, in the early days, this item was often omitted.

The cost of transport between farm and dryer varies a lot. In 1951 it varied between 1½d. and 3s. per cwt. of dried product. The average cost of transport was 1s. 8d. per cwt. of dried product.

Dutch Developments in the Tropics

It is reported from Holland that a Dutch team of agricultural experts have been visiting the French Congo region of Niaridal with a view to the possible establishment of large-scale projects in the district. Investigations undertaken by the experts during their visit covered a wide range, including the possibilities of developing oil-bearing plants and rice as well as the growing of sugar beet. The sugar factories at Moerbeke in the lower Congo were visited.

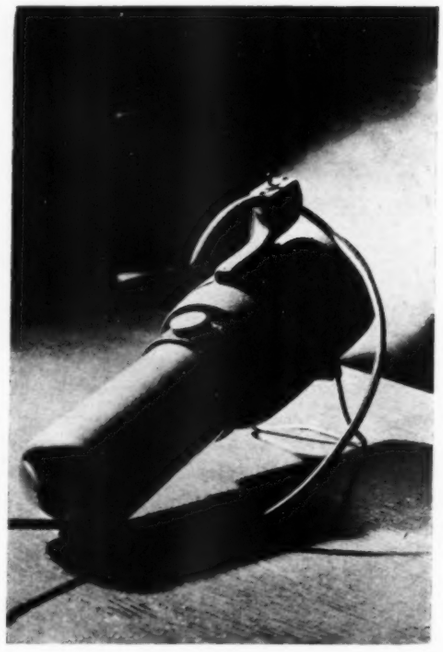
A company, to operate with Dutch, Brazilian and American capital, has already been established for the exploitation of tropical plantations in Brazil. It is planned to recruit Dutch staff trained in Indonesia. This company has obtained an option on some 500,000 hectares on the Maraca in Lamapa near French Guiana. After clearing the timber the cultivation of oil-bearing seeds and rubber will be further developed. Other possible crops will be cocoa, coffee, rice and sugar cane.

Insecticidal Aerosols in Flour Mill Premises

AN entirely unpremeditated use of liquid insecticide in aerosol form was made in the summer of 1952 in certain sections of two flour mills, one in the north-west, the other in the south-east of England. This usage occurred through the need to carry out a treatment of screens and provender sections immediately preceding hydrogen cyanide fumigation of the mills proper. The treatment intended to be used consisted of smoke treatment by means of BHC smoke generators, but difficulty in obtaining supplies of these at short notice made it necessary to determine an alternative procedure.

The method finally employed consisted of application of a BHC/Pybuthrin insecticide in heavy refined white oil in aerosol form. Specifically the insecticide contained Pybuthrins of biological equivalent to 0.4% total pyrethrins and 0.2% gamma BHC in Shell Oil Risella 17. The dosage employed was intended to produce the same gamma BHC deposits as would be achieved by use of BHC smoke generators at the rate prescribed by the manufacturers for grain weevils. An American-built Microsol Model 303 was used to disperse the insecticide in the mill in the south-east of England, whilst multiple British-made Microsol Models 202 were used in the north-west mill. Infestation in both premises consisted mainly of mill moth, grain weevil, spider beetle and other beetles associated with milling.

In both cases immediate results were found to be at least as good as would have been expected through use of BHC smoke generators alone. Long-term results



Microsol Models 202 of this type were used in the north-west mill

were not expected by either aerosol or smoke treatment, such results being rendered negligible because of settling dust produced by milling operations.

From these treatments, which were the first to be carried out with Microsol in flour mills in Great Britain, several interesting features appeared, and are considered sufficiently important to warrant further investigations:

(1) On the larger job in the south-east (approx. 600,000 cu. ft.) the total cost was appreciably less than would have been incurred by using smoke generators.

(2) On the smaller job in the north-west (approx. 95,000 cu. ft.) the total cost was slightly more than would have been incurred by using smoke generators.

(3) No sealing-up was carried out at all and this would certainly have been necessary for treatment with smoke.

(4) The success of the treatment in this case justified the means. Very little preparation was necessary for the jobs, the millers were quite happy that no risks were involved in the treatment and the labour requirement in each case was very small.

(5) It was surprisingly obvious in both cases how rapidly the aerosol became distributed throughout the premises —adult Ephestia appeared to be irritated within a matter of seconds and became very active even in the unheated portions treated. It seems that a small dosage of, say, a 0.4% pyrethrins insecticide would serve to indicate the extent of adult Ephestia infestation; certainly in both the jobs in question this population was three to four times that estimated by inspection.

N.B.—In points (1) and (2) above the difference in costings is largely due to costs of materials; if a straight BHC spray had been employed, total costs in both cases would have been much less than by using smoke generators.

Austrian Forest Products Laboratory

On July 1 a new forest products research laboratory was formally opened at Vienna and Austria became one of the growing list of countries equipped with central institutions for this purpose. Much wood research has already been done in Austria by individual scientists working in the laboratories of different universities, but up to the present the country has not had the great advantages that exist in a central institution where scientists with different specialities combine their skills in the solution of research problems. A group of scientists working together in harmony in a well-equipped laboratory can accomplish much more than when each must work by himself.

Wood is of great significance in Austrian economy and wood products constitute one of the most important factors in maintaining Austria's trade balance with other nations. Although Austria has large forests, she does not necessarily produce cheap timber, because much of its grows in mountainous regions where the cost of logging and transportation is high. The long rail or truck hauls to deep water for foreign shipment are also a cost handicap to Austrian lumber and wood products in world markets. These facts, and the necessity of keeping the annual timber cut in balance with annual growth, make it imperative for Austria to operate its wood industries with the greatest efficiency in the use of both material and labour. This situation provides the incentive for research and development in the field of wood utilisation and has resulted in the decision to build a central institution for the purpose.

The Austrian Forest Products Laboratory is sponsored, managed, and supported by the Austrian Society for Wood Research. This organisation is primarily an industrial rather than a governmental group, but contains in its membership and managing board representative scientists and government officials as well as representatives from industrial firms and organisations.

The work of this laboratory with the wood-using and wood-processing industries, together with the favourable influence of the new sawmill school at Kuchl, in Salzburg, will go far in helping Austrian wood industries and lumber manufacturers to make great improvements in their efficiency.

A British Forestry Demonstration

A COMBINED demonstration was organised recently by County Commercial Cars Ltd., T. T. Boughton and Co. Ltd., and Elgin Central Engineers Ltd., three firms who specialise in producing suitable equipment for timber extraction work. The demonstration was held on the Darnaway Estates, Forres, Morayshire, an area which was badly damaged by the severe gales at the end of February. On this estate, which covers a total area of about 28,000 acres, no less than 4,000 acres are under timber. Of these, about 200 acres of mature trees were affected by the 'blow.' It is difficult to assess the value of the magnificent trees which now lie in tangled heaps, but it is safe to say that, due to the tremendous amount of timber which was uprooted, values are only about one-third of what they should be. Local mills are inundated with material, and haulage rates to more distant mills are very high.

The scene of devastation at Darnaway Estates in Morayshire

Bomb blast effect

The effect of the gale, which at times reached estimated wind speeds of well over 100 m.p.h., was peculiar. It could be likened to bomb blast inasmuch as there was no defined pattern of damage. The exposed slopes, which one would expect to take the main force of the gale, were in many cases undamaged, while other areas, deep in the heart of a mature forest, have been uprooted. Again, trees had not fallen in any one direction. The result was a mass of roots, trunks and tops piled one on the other. This in itself proved quite a test for the equipment which was demonstrated.

On Darnaway Estates the biggest single area affected by the gale was over 60 acres, but there were many other sites ranging from a few hundred square yards to several acres in area.

Problems facing estate owners

The problems facing estate owners are complicated, but the most pressing need is to extract the timber as quickly as possible. Foresters emphasised that the beeches should be extracted within six months, otherwise discoloration of the wood takes place. Coniferous timber should be taken out inside 18 months.

The ' build-up ' of pests caused by timber lying too long can cause permanent damage to standing trees; access to the sites is often difficult and haulage problems are immense. One timber contractor has been trying to charter ships to move the timber to mills in the south, but freight costs are very high, whether by road, rail or sea.

Demonstration of British equipment

Elgin Central Engineers Ltd. sent out 450 invitations to contractors, estate owners and other interested concerns, and despite inclement weather there was an intense interest in the machines at work.

The ' County Commercial Crawler ' was demonstrated with winches, timber arches and bulldozing equipment. The ' Boughton Winch,' designed by T. T. Boughton and Co. Ltd., fitted to this tractor, is said to have been ideal for this work. The ' Braydozer ' fitted to the crawler had many uses in these badly damaged areas. Making roadways to the sites, bulldozing debris and tops, and pushing stumps back into the ground were but a few of the tasks it performed. The new ' Oliver ' timber arch caused interest as this machine has been designed to permit maximum manoevrability, most of the weight of the log being taken over the axle of the machine, thus ensuring that there is no interference with track adhesion.

Skid pans used in conjunction with a winch were also demonstrated. These not only lighten the load on the winch or

The Braydozer, which was used to clear roadways and debris, is shown here fitted to the Fordson Major with county full tracks

tractor but also prevent the ugly scars which the butt end of a log normally makes when it is towed over the forest floor. The mobility and manoevrability of the Danarm range of chain saws could not have been put to a more severe test. The tangled mass of trunks, branches and stumps made lopping and trimming most difficult. But this Danarm equipment, in the hands of skilled operators, is stated to have certainly saved an immense amount of time.

Microsol Director's Tour

Mr. William M. Healy, a director of Microsol Industries Ltd. and vice-president of Silver Creek Precision Corp., which manufactures Microsol equipment in the United States, has just completed the second half of a world tour during which a number of new distributors were set up, and a great deal more information obtained concerning the success of Microsol equipment in overseas territories.

Mr. Healy visited Mexico, Ecuador, Peru, Brazil, Uruguay and Argentina, thence to England through Portugal and Spain. He reported to the Board of Microsol Industries Ltd. in London that the acceptance of the principle and performance of the company's equipment was growing fast and that there would have to be a substantial increase in the output of models to meet the demand now being created as a result of the original demonstrations and trials carried out 18 months ago.

Technical News

In the August issue of **Chemical and Process Engineering** there is ' A Review of Catalysis,' by S. L. Martin, and an article on ' Modern Techniques in Non-Ferrous Ore Dressing.'

Building Digest for August features the first part of an article by S. Gordon Joseph entitled ' Post-war Building Progress in Germany.' There is also an article on ' New Building Methods in the U.S.S.R.'

Muck Shifter includes a study on ' The Reconstruction of the North Docks of the Port of Liverpool.' In addition, there is an article on ' Construction Work for the New Puerto Rico International Airport.'

In the August issue of **Atomics** there is an article by M. Ross and Dr. A. Charlesby on ' The Effect of Pile Radiation on Polymethyl Methacrylate (Perspex).'

The tractor is demonstrated in the drained lake

British 'Rice Field' Demonstration

Truly, there is no end to the enterprise and ingenuity of agricultural machinery manufacturers. We gather that recently a Burmese trade delegation, which was in this country, paid a visit to a firm of machinery manufacturers in Yorkshire where they were given a realistic demonstration of the way in which a tractor can operate under field conditions similar to those which occur on rice plantations in Burma. Apparently, a disused, partly drained, ornamental lake in the grounds of a former country mansion, which is now used to accommodate employees of the manufacturing firm, was used for this purpose, the drained lake bottom sufficiently resembling the muddy conditions usually encountered when ploughing rice fields. We are told that the tractor used was equipped with special tyres and with suitable implements for cultivating a rice field (in this case a Rotavator produced by Rotary Hoes). The tractor ploughed steadily along the bed of the lake with its front wheels completely, at times, submerged in water. It is interesting to note that in the cultivation of rice fields the principle involved is the exact opposite from that which is sought in ordinary dry-land cultivation, namely, the breaking down of the structure of the soil as far as possible, combined with the creation of a plough pan at the base of the working level which helps to hold water on the land. For operations of this type, the Rotavator could hardly be bettered.

Latin-American Seminar

The study of land policies, land tenure and land reform problems in Latin America was the subject of a five-week seminar which was held in Campinas (Sao Paulo), Brazil, in May and June. Jointly sponsored by FAO and by the Government of Brazil, this seminar provided an opportunity for agricultural technicians from all over the region to discuss agrarian structures and land tenure systems in Latin America. It also suggested ways and means of improving agrarian structures in order to help the economical and agricultural development of this area.

The Latin-American Seminar on Land Problems was planned to implement the resolution on agrarian structures of the sixth session of the FAO Conference which recommended ' holding a Latin-American meeting on land and water utilisation and conservation problems and policies,' as well as to give effect to the several individual requests made to FAO by Latin America member governments to help them solve their agrarian problems.

It is widely recognised that the existing agrarian structures under which land is held and occupied in many Latin-American countries is ill-adapted to the economic and social goals these countries are seeking, and it is frequently an obstacle to the best use of natural and human resources. In the past years the United Nations has placed great emphasis on land reform as a means to furthering economic and social development, and FAO, because of its special interest in increasing food production and improving the living conditions of rural populations, has naturally assumed a leading role in this effort. The seminar was the first regional activity by a United Nations agency to promote land reform.

Australian Farming Notes

(From Our Australian Correspondent)

Wheat crops

In giving figures for the disposal of Australia's 1952-53 harvest, the Wheat Pool of Western Australia stated that 178½ million bushels of wheat had been delivered by growers. With a carryover of 18 million bushels, this made 196½ million bushels available for all purposes. Local flour needed about 38½ million bushels of wheat, while stockfeed and sundries required a further 17 million bushels. Export flour sales accounted for over 26 million bushels and export wheat sales for another 43 million bushels. This accounted for 125 million bushels of the 196½ million bushels available. Another 20 million would be required as a carryover, so that 51½ million would remain available for sale.

Land developments

Dramatic opportunities for the development of about 340 million acres of unimproved land in the areas of better rainfall of Australia are being revealed by research into deficiencies of the trace elements, such as copper, zinc, molybdenum and cobalt. Commenting recently on the results of these investigations, Dr. J. Griffiths Davies, associate chief of the C.S.I.R.O. Division of Plant Industry, said that apparently this new knowledge would allow Australia to drastically revise its possibilities for development. He stated that it was now realised that the recent transformation of poor scrubland in Western Australia and the Ninety-Mile Desert in South Australia to highly productive pasture was only a prelude to similar improvement throughout all better rainfall areas. He pointed out that one-third of Australia, or about 600 million acres, is relatively well watered. Broadly, it represents areas with rainfall above 15 in. in South Australia, above 20 in. in Queensland and above 30 in. in the Northern Territory and the north of Western Australia. Even excluding the Northern Territory, the proportion of undeveloped country in these areas is enormous. It represents 445 million acres, compared with 29 million acres now used for crops, 27 million acres for forest, and 18 million acres of improved pastures.

Research developments

About 150 varieties of rice are now under test at the Kimberley research station. This was disclosed recently by the chairman of the supervisory and policy committees of the station, Mr. C. S. Christian. After some difficulty many of the varieties had been secured from rice-growing countries outside Australia. Several appeared better than any variety previously tried under Kimberley conditions, but they could not be tested on large areas until seed supplies were built up. Sugar cane was another crop receiving particular attention and 15 acres were being sown this year. Considerable experience had also been gained over the past two years with grain sorghum, peanuts, cotton, sunflower, safflower, linseed and the fibre crops jute and kenaf. Several types of irrigated pastures, including paspalum, scrobiculatum, para grass and the legume clitoria, had also been grown and grazed by cattle. The research station, which is controlled jointly by the Commonwealth and State Governments, is principally concerned with how best to use ' black ' soil under irrigation.

General Templer, the High Commissioner for Malaya, discusses the Howard Rotavator with representatives of Guthrie and Co. Ltd., the Malayan distributors of Rotary Hoes Ltd., during his visit to the recent Malayan Agri/Horticultural Association Exhibition at Kuala Lumpur

West German Agriculture

It is reported that the Agrarian Committee of the West German Bundesrat (Upper House) has asked the Government to stop the further liberalisation of agricultural imports.

The committee said that German agriculture was ' exposed to the unbearable competition of foreign countries by an increasing liberalisation of imports.' Foreign farmers could produce more cheaply than the German and endangered West German production. Only if German agriculture was protected could it increase productivity.

The motion stated that agriculture should receive at least 30% of the 118,400,000 marks of Mutual Security Agency credits earmarked for the West German productivity programme.

Rubber Federation President

Mr. P. W. Howard, managing director of the British Tyre and Rubber Co. Ltd., has succeeded Mr. John H. Lord, the Dunlop director, as president of the Federation of British Rubber Manufacturers' Associations.

Mr. Howard began his business career with the Hoffmann Manufacturing Co., Chelmsford, and was sales manager of the Pyrene Company and of Pirelli Ltd. before joining the British Tyre and Rubber Co. as sales manager in 1926. After becoming their general sales manager and, in 1949, sales director, he was appointed managing director in 1951.

RESEARCH DEVELOPMENTS

Organic Weathering of Minerals and Soils

GROWING interest attaches to the manner in which soils are formed and many workers of late years have been engaged in studying the manner in which minerals are broken down to form soils in the course of natural weathering. In particular, in recent years, many studies have been made by Russian workers on the early stages of soil formation from massive crystalline rocks, the main object being to ascertain the effect of pioneer organisms, particularly lichens and mosses on the decomposition of rock. Recent developments in this connection have been summarised by G. V. Jacks in an article published in *Science Progress* and subsequently reprinted in *Soils and Fertilisers*, and from this the following summary has been abstracted.

The role of living organisms

Among the Russian workers, Polynov has been prominent. In 1945 he concluded from numerous observations that the finer particles of mineral soils cannot have been produced by purely mechanical means, and were not produced by inorganic chemical weathering. He came to the conclusion that they are the result of the action of living organisms on massive rocks and the subsequent decomposition of their bodies leaving a synthetic clay-humus residue.

He argues with most other Russian workers that if weathering was simply a process of physical and chemical breakdown of primary rock minerals, nearly all unstable minerals should by now have disappeared from the earth's crust; that they have not done so seems to be at least due in part to the effect of living organisms. Polynov also maintains that the occurrence of sterile weathering even under desert conditions is doubtful.

Action of lichen

His studies were carried out on granite-gneiss rocks and showed that the first visible stage of breakdown of the rocks is caused by the activity of lithophile lichens which in a comparatively short time produce a horizon of organo-mineral dust on the earth surface and penetrate and disintegrate the solid rock with their hyphae. This organic weathering leads to an accumulation in finely divided form of elements primarily needed for plant growth.

Polynov drew special attention to phosphorus in lichens and concludes that this is an important factor in transforming the phosphorus content of apatite in the original rock into forms available for higher plants.

During the humification and mineralisation of lichen residues a synthesis of new vadose minerals occurs, *e.g.*, of vadose quartz and aluminosilicates of the montmorillonite type in which aluminium is replaced by magnesium.

Brobritskaya has recently produced evidence that the concentration of organogenic elements such as phosphorus, sulphur and potassium by lithophile vegetation is a general phenomenon and occurs equally on acid, basic and calcareous rocks, but the nature of the rock itself influences the generic nature of the lichens and mosses and this in turn determines the composition of the ash and the quality of the organo-mineral ' fine earth ' produced during subsequent humification. On acid rocks the genus *Parmelia* predominated, on basic silicate rocks *Xanthoria parietina* was characteristic, while *Leucanora crassa* and *Acarospora* were only found on calcareous rocks. The different kinds of lichen and mosses varied in the proportions of the elements found in their ash but all had high contents of phosphorus and sulphur. The lichen *Gyrophora* and the mosses collected most potassium and *Parmelia* much iron.

Krasilnikov found a considerable microflora on bare mountain rocks both acidic and basic and covered with or free of lichens. In this bacteria predominated with some fungi and actinomycetes. The bacteria found differed from those found in mature soils; azotobacter was absent, while numbers varied from 5 to 50 million per gramme.

Algae diatome fungi and bacteria

Glazovskaya reported in 1950 that on mountain rocks he had found new signs of biochemical weathering as a result of microflora. The most active agents were green and blue-green algae and diatoms. The products of weathering included amorphous silica and synthesised aluminosilicates. Algae are able to remove calcium carbonate from solution and transform it into calcite, and some green algae accumulate iron and manganese.

Parfenova found that where lichen dust from diorite had accumulated at an altitude of over 4,000 metres mosses grew and also alpine grasses where the accumulations are sufficiently deep. In such cases the grass roots penetrate the underlying rock and split it into slabs, the crevices between which are filled with dust and decaying roots. Among minerals which resist inorganic weathering are quartz, zircon, titanite, epidote and magnetite; minerals which disintegrate regularly include amphibole, plagioclases and apatite; the most unstable minerals are chlorite and some transformation products of plagioclase. As a result of weathering and the action of organisms on the above groups secondary vadose minerals are formed, including sericite, muscovite, calcite, montmorillonite and secondary quartz.

Yarilova in 1950 studied similar primitive soils, a few centimetres thick, formed from syenite, and found that the weathered minerals consisted mainly of plagioclase, chlorite and hornblende. At the stage of soil development when grass appeared, about 30% of the minerals were new synthesised products. Lichen hyphae had split the plagioclase crystals into small particles.

Algae in arid regions

Bolyshev studied the effect of algae on the formation of the alkaline soils of arid regions. Such soils are of heavy texture with accumulation of silica in the surface horizon and of sesquioxides at some depth indicating a breakdown of aluminosilicates. Experiments showed the powerful effect of blue-green algae in decomposing soil minerals. Bolyshev thought that the silica released by algae may be utilised by diatoms which accompany the algae in soils of this type.

Finally, Alexsandrov and Zak have described a bacillus which they isolated from soil by culturing on silicate agar, which was able to make potassium available to plants. When seeds of wheat or maize, or the soil growing these plants, was inoculated with this bacillus grain yields were increased by 50% to 100% over the control fertilised with NP.

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NEW BOOKS

The Yields of a Crop

By W. L. Balls, C.M.G., C.B.E., Sc.D. (Cantab.), D.Sc.(Mancs.), F.R.S. Pp. 144+xv, illustrated. E. and F. N. Spon Ltd., London. 1953. 21s.

Dr. W. L. Balls' new book may disappoint some by its title. Those who look for a general study of this problem will find instead that it is devoted almost entirely to the Egyptian cotton crop, and that in addition it treats this almost entirely from the point of view of the study of subsoil water. Dr. Balls' early work in Egypt, before the First War, convinced him of the importance of water-table effects on the crop, and his summing up of a lifetime's experience seems to have confirmed him in this point of view.

Egyptian irrigation was originally of the type known as basin, that is, the summer flood was allowed to fill up in turn controlled areas in which, as the water was let off, a crop was sown on the drying mud. Since this only allowed the cultivation of a summer crop, like cotton, by artificially raised water it was decided to change this system to a regular canalised supply—perennial irrigation, as it is called.

Unfortunately, the increased supply has had the inevitable effect of raising the level of the underground water-table. Dr. Balls proves this fact in Egypt, with a wealth of detail, both statistical and graphical. He also claims to show that the detrimental effect this has on the crop has negatived all the recent improvements in cultural methods, pest control, and new varieties. In effect, these provide increments to a basic yield which he considers as steadily falling, leaving the actual level of yields much where it was at the beginning of the century.

It is a depressing picture and, if true, could only be altered by a fundamental change in present irrigation methods, as to the probability of which, in the near future, Dr. Balls is frankly pessimistic. The organised study and planning required will not be easily forthcoming in a country so beset with its immediate political preoccupations.

The experience of Egypt certainly has a much more generalised application. The water necessities of an irrigated crop in the tropics or sub-tropics are necessarily somewhat at variance with the requirements of soil aeration and a free root run in non-waterlogged soil. The irrigation engineer is inevitably thus rather placed on the horns of a dilemma. Most of them perhaps already realise this and the modern awareness that drainage facilities should at least keep pace with irrigation, or even precede it, is a proof of this realisation. There are also some irrigated areas where the problem will always be not enough water, rather than too much. For example, in the irrigated California valleys the too rapid exhaustion of underground water by pumps means that these pumps must be continually sunk to greater and greater depths.

None the less, it is possible that there are other major irrigated areas where the basic problems present a close similarity with those of Egypt. It is in these that Dr. Balls' arguments should be most carefully studied.

C.H.B.

Farm Glossary

By L. S. Wolfe. Pp. 360. L. S. Wolfe, Orangeburg, S.C. 1949. $1.50.

This is a glossary of words and phrases encountered in reading agricultural and scientific literature. As stated in the preface the book is not offered as an exhaustive presentation, but is thought to be comprehensive enough to be of real value to farmers and students of agriculture. The book is certainly comprehensive, and to all those for whom it is intended it should undoubtedly prove useful.

400 Plants of South Florida

By Julia F. Morton and R. Bruce Ledin. Pp. 134, illustrated. Text House Inc., Florida. 1952. $3.50.

This book appears to be written for the benefit of the layman who wishes to obtain some knowledge of the commonly occurring plants in Florida rather than for the scientific specialist. In it, some 400 plants of Southern Florida are carefully described with numerous illustrations. In the words of the authors, technical terms have been carefully avoided. Both popular and scientific names are given. The result is an attractively got-up and beautifully illustrated work which should amply fulfil the purpose of its authors.

American Tomato Yearbook—1953

Pp. 40, illustrated. C. S. Macfarland, Jnr., New Jersey. 1953. $2.00.

We have recently received the 1953 edition of the *American Tomato Yearbook*, which is published by C. S. Macfarland, Jnr. As usual the book is full of useful information to tomato growers, particularly those in the United States. A particularly useful factor of it is the list of recent publications on tomato cultivation which appear on pages 16-22. Other useful information is the series of tables showing the production exports and yields of fresh tomatoes in the United States for a number of years back. In addition, the book contains many other matters of interest to tomato growers.

The Mechanical Dehydration of Fodder

(*From our Italian Correspondent*)

At a recent lecture to the Agrarian Society of Lombardy, Prof. Tallarico described a new machine devised by Dr. Fanelli for the mechanical dehydration of fodder. This machine cuts, crushes, squeezes and disaggregates fresh grass, the product yielded being a deplasmed grass fit for immediate consumption by cattle for storing and a vegetable juice, which was called by Prof. Tallarico plasma and which can be used in many ways. The deplasmed grass is more easily digestible than fresh grass and is partially freed from the hydrosoluble substances contained in young grass, which causes springtime diarrhoea in cattle. The treated grass is fit for storage without any withering, while the treated grass having been cut and crushed can be pressed so as to limit penetration of air. It is then rapidly transformed into good hay by exposing it to the sun for a few hours. The hay has advantages because of its disaggregation ; when baled it occupies only two-thirds of space in comparison with normal hay and is more appetising, while the nutrient value is enhanced owing to the higher protein content. It permits hay-making in every season of the year and even in bad weather, whilst optimum nutrient value of the grass allows one to cut the grass more. It is claimed that the so-called plasma is a valuable feeding stuff because of its high content of vitamins. When not in immediate use, plasma can be preserved by means of concentration.

WORLD CROPS

IN OUR NEXT ISSUE, there will be an article on **Permanent Agriculture in Southern Rhodesia** by J. W. Rowland. **Robusta Coffee** will be discussed by A. E. Haarer, and **The Harvesting of Fibre Flax Crops in Australia** will be described by W. L. Greenhill. There will also be additional articles besides the regular features.

Recent FAO Publications

THE publications issued by the Food and Agriculture Organisation of recent months have increased in number, size and importance. Today the books and pamphlets appearing under their auspices in content, authorship and manner of presentation challenge comparison, as indeed they should, with those issued by any national agricultural organisation. Lately, a number of works dealing with various agricultural aspects of land use have appeared which demand rather more than passing notice, since they cover subjects of world-wide importance and include most of the many aspects which they present in practice. These are dealt with below.

Legumes in Agriculture, by R. O. Whyte, G. Nilson Leissner, and H. C. Trumble. Pp. 367. April, 1953.

This work, upon which FAO has been engaged for many months past, must be regarded as an achievement of major importance, inasmuch as it aims at giving an account in simple and easily understood form of the whole range of leguminous plants used in agriculture throughout the world and their importance, mode of functioning, growth habits, and associations, together with an epitome of the manner in which they are applied in husbandry practice. The high reputation of the several authors is sufficient guarantee that the work will be efficiently performed, and when regard is had to the list of over 110 authorities who have been consulted or have made contributions to the various sections of the work, its authoritative nature and importance is beyond question.

The book is divided into two parts. In the first, general questions in connection with the growth and significance of leguminous plants are considered and discussed, such as botanical relationships, relations to soil fertility, associations with grasses, symbiotic nitrogen fixation and similar matters. In the second part, descriptions are given of a large number of genera of leguminous plants and of particular species grown under different geographical conditions.

The work itself is well printed and is illustrated with a large number of photographs excellently reproduced. It seems bound to take its place as an authoritative work on a subject of world-wide importance. The main criticisms to be offered are, first, that having regard to its character the work is worthy of a somewhat more robust form of presentation than FAO have been able to give it: the book should be bound in cloth in view of the frequent handling which it is bound to receive; the second criticism is that failure to provide an index to a book of this type must be reckoned a major fault. In fact, to the reviewer the prospects of having to use the book without a reliable guide to its contents in the shape of an index is a prospect which fills him with alarm and dismay.

Soil Conservation, an International Study. Second printing. 1952.

This is the second edition of one of FAO'S earliest efforts in the line of publications, which at the time of its original issue attracted widespread appreciation and admiration. In the interval, some advances have been made in soil conservation practice, but the new edition contains no appreciable amount of new matter. Nevertheless, the book remains a valuable source of information and reference.

One notices with regret, however, that there has been a decided falling off in the quality of paper on which this edition is printed which detracts from the reproductions of the many excellent illustrations. Also, once more, one cannot help regretting that a more robust binding has not been adopted for this excellent work, while the absence of an index is a regrettable omission.

Grazing and Forest Economy

This is the third of the works on land use recently issued by FAO. It is published on the responsibility of the forestry division of FAO, but it would appear to be a collaborative production between the forestry and agriculture divisions. Indeed, one of the many useful services FAO is doing is its efforts to bridge the gap which for many years has existed between agriculture and forestry, and to gain acceptance for what should be obvious, namely, that they are but two closely related aspects of land use, and that the sharp division on which many people, notably foresters, have frequently laid stress, between the two subjects exists in reality only in their imagination.

The point that is made in this publication is that in land utilisation the plant cover should be adequate not only to feed livestock but also to protect the watershed. Moreover, many woody plants may serve equally as food for livestock or wild animals and to provide man's requirements for wood, either as fuel or for building.

The term 'natural grazing grounds' may well be used to describe almost any land covered with natural vegetation; it can be applied either to forest or to lightly timbered grassland or to open grassland without trees. It is true that on occasion dense forests are found that cannot be grazed or areas invaded by some particularly noxious weeds which defy penetration, such, for instance, as the prickly pear thickets which occurred in South Africa before the means of biological control were discovered.

Land management must, of course, be largely decided upon by the prevailing climatic conditions; also, for practical purposes, there must be some division and the parts which are going to be used for timber production divided from those which are destined for grazing, but the division is at best an arbitrary one and in principle the one shades imperceptibly into the other. These various aspects as presented in various parts of the world and under varying climatic conditions are discussed in the book and various difficulties and drawbacks which can arise are considered. The book is worthy of careful study by all interested in land use problems. It is well printed and illustrated.

The Yearbook of Agricultural Production for 1952.

This is Part I of the annual year book of agricultural statistics for mondial agricultural production which FAO has produced each year since it started operating. As usual, it summarises in the form of tables statistics concerning the agricultural populations, production of crops and livestock, and prices for the principal countries of the world. It is an invaluable summary and epitome to which all interested in agricultural questions should have access.

H.T.

Caterpillar Plant

Plans for the construction of a new plant, at a location not yet determined, were announced recently by the Caterpillar Tractor Co. The new plant, occupying 700,000 sq. ft. of manufacturing floor space, will be devoted to the production of the company's line of motor graders and industrial wheel tractors. This move is being made to accommodate at Peoria a broadened programme of crawler tractor and diesel engine manufacture. This enlargement and rearrangement of manufacturing facilities and the construction of the new plant are expected to be completed by the end of 1955.

Reports and Publications

East Malling Research Station

The annual report of the East Malling Research Station for 1952 covers the work accomplished between October 1, 1951, and September 30, 1952. This is the fortieth year of continuous work by this celebrated experimental station, and as usual the report is full of interesting matter.

It is arranged in four parts. The first contains the farm report, in which is outlined the treatment of the various experimental plantations and fields and the size of the crops harvested. Crops as a whole were good, but the marketing of some of the fruit, especially cherries and plums, was difficult. This part opens with a summary of the acreages devoted to the different crops; it is interesting to note that of the total 363 acres, 40 acres are occupied by buildings, roads, woods and water, 193 acres are in use for experiments, and 130 acres are arable in preparation for future trials, or nursery. A part of the arable area comprises land that is unsuitable for experimental use.

Part II reviews the progress of the research programme as a whole, calling attention to the more important advances. Careful reading of this part will reveal that all the main problems of fruit growers are under active investigation. A full list is given of the publications produced during the year.

Research reports and reviews comprise Part III. They are written mainly for fellow scientists, but although some of them may prove too technical for non-specialist readers, the majority of the papers will interest many growers, both commercial and amateur. The full text is given of the fifth Amos Memorial Lecture by Prof. H. B. Tukey on the subject of developments in fruit culture in America. It also includes papers on the new Malling-Merton rootstocks, spring frost damage, the designing of experiments, the assay of growth substances, special culture methods of growing trees, the analysis of leaves, diseases, especially Verticillium wilt of hops and virus diseases, concentrate spraying, various pests and beneficial insects, and the glass slide test for fungicides. In all, Part II contains 27 separate papers.

Eight bulletins for growers appear in Part IV. Written in non-technical language, these bulletins make available to the grower the practical results of research. They deal with the new woolly aphid-resistant rootstocks for apples, irrigation requirements of orchards, ' double-shield ' budding of pears, strawberry varieties, virus diseases, and the agreed common names which are intended to simplify reference to the many complex chemicals used nowadays.

The report is fully illustrated with many line drawings and 36 pages of photographic plates. It contains a list of the governing members of the society, the executive committee and the staff, and has a very complete four-page index.

It will as usual be found to be full of interest to fruit growers all over the world. It can be obtained on application to the East Malling Research Station, near Maidstone, Kent, or through the usual trade channels. The price is 12s. 6d. post free in Great Britain only, or $2.00 U.S.A. currency, overseas postage being extra.

The East African Agriculture and Forestry Research Organisation

The appearance of the annual report of EAAFRO must be recognised as an event of some importance. 1952 is the first full year in which the scheme has been working in its entirety at the headquarters established at Muguga. As was to be expected, a number of matters arose which required adjustment and improvement; none were, however, serious and most apparently proved capable of local adjustment.

The year was, however, rendered difficult by reason of the declaration of a state of emergency in October, 1952, which caused interruption of the research programmes which might have been serious had it not been for the loyalty and determination of the staff. To this the director pays well deserved tribute in his introductory remarks.

The report is of considerable length, running to over 100 pages; it is impossible, therefore, to do more than mention a few of the more salient points. That the work of the organisation is arousing widespread interest is obvious from the number of visitors, which exceeded 400; about half were in organised parties. As the work of the organisation increases these may be expected to increase and when this occurs it seems probable that special arrangements may be needed to cope with them and to relieve the scientific staff from the duty of dealing with visitors other than specialists.

New sections of work

With the opening of sections for forest entomology, soil physics and soil microbiology the research programme of EAAFRO can now be said to be fully under way. Forest entomology is of obvious importance in view of the extensive damage to East African timber, which adversely affects its prospects in both internal and external markets. Soil physics is of the utmost importance in tropical and sub-tropical climatic conditions. Its findings extend far beyond mere agricultural utilisation, to the controlled exploitation of underground water resources for industrial purposes. Soil microbiology of tropical soils is a practically unknown field. It has an intimate bearing on the fertility level of soil, and is one of the important lines of study if stable agricultural systems are to be devised to replace the centuries-old practice of shifting cultivation, which is no longer possible owing to the increasing demands on the land (pages 6-9).

A forest policy for East Africa

This is perhaps the most important section of this year's report. The comment on pages 9 and 10 is based on the full report by Dr. Hursh, a senior research worker in the United States Forest Service. This report appears on pages 26-35. Dr. Hursh uses examples from Kenya, Tanganyika and Uganda to stress the grave damage that has already been done through the lack of a positively controlled overall policy of forest management based on the catchment area as a unit. His comments on the policy, or rather lack of policy, in the Shimba Hills, Kenya, for example, are most interesting, and he gives equally cogent instances from Tanganyika and Uganda. One of the important functions of an inter-territorial organisation like EAAFRO, besides conducting basic research on an East African basis, is to bring together the research and technological interests from each territory for joint discussion and for the co-ordination of plans (pages 9-10 and 26-35).

Co-ordination

The organisation of an inter-territorial research centre, especially one serving colonies that are not yet fully developed, involved a number of novel problems. One of the most important was to remove fears that there would be insufficient contacts between the research centre and the territories. This fear was based partly on a misconception of the manner in which scientists set about their researches and partly on a lack of appreciation of the close contacts that any scientist necessarily makes with his ' opposite numbers ' working in other places. Although EAAFRO has only been fully functioning for a very short while, a high degree of co-operation and co-ordination with all other scientific and technical centres concerned has been

effected. These are detailed in this year's report at some length, and the conclusion is drawn that, paradoxical though it may seem, the less the administrative machinery for effecting co-ordinating the better the co-ordination (pages 11-15).

Conclusion

We have already commented upon certain aspects of this report in an editorial comment last month. We can only repeat here that it is extremely satisfactory to one who, like the present reviewer, can claim to have played some small part in the initiation of the project to see it arriving at full fruition and functioning efficiently. Proof of this appears to be given by the impressive list of scientific papers published since the scheme was launched.

H.T.

Insecticides, Fungicides and Fumigants

We have received from the Murphy Chemical Co. of Wheathampstead, Hertfordshire, a copy of the 1953 edition of its pamphlet bearing the above title. Like its predecessors, it aims to bring together for the benefit of growers up-to-date information and recommendations on the use of insecticides, fungicides and fumigants. Of late there have been a number of important advances in the use of these substances and the new publication presents these in a handy and readable form. The book will be found to be very useful by all those for whom it is designed. Included with it is a card summarising the protective measures needed when handling poisonous phosphorus and dinitro insecticides in the field. The book is obtainable on application to the company.

The Institute for Seaweed Research

The annual report of the Institute for Seaweed Research has recently appeared, covering the work of the year 1952. The Institute is under the direction of Dr. F. H. Woodward, from whose pen an article discussing the scope and objects of research on the seaweeds occurring round the coasts of Great Britain appeared in World Crops, **4**, 403.

It is satisfactory to notice that during the period covered by this report, for the first time, the Institute has had a full complement of scientific staff, and that consequently it has been possible to tackle all the problems which have been given prominence in its programme of research.

The report lays considerable emphasis on the work done on resurveying certain sub-littoral seaweed beds, with the object of testing the methods hitherto employed in surveying seaweed growth and its annual variation. It is satisfactory that these appear to be entirely reliable. Importance also attaches to the considerable amount of work done on assessing the feeding value of different seaweeds and on their ensiling for fodder as seaweed is used to an appreciable extent for feeding to stock, and there is apparently no reason why its use in this direction should not be considerably extended.

A good deal of attention was given to investigating various methods of collecting and harvesting seaweed, while interest attaches to work directed to assessing the chemical composition of brown seaweed and other forms, and the value of chemicals derived therefrom.

In particular, the vitamin contents of certain varieties have been assayed, and attempts made to assess the value of the algal products of a number of species. The work of the Institute in investigating the possible large-scale utilisation of these natural resources, which have hitherto been largely neglected and only utilised in a restricted degree, seems not unlikely in the future to have important practical results.

Brazilian Fruit Yearbook

We have received a copy of the first number of the *Yearbook of the Brazilian Fruit Trade*. This is a well got-up publication and is printed in Portuguese. It appears to be full of information that will be of value to fruit growers in Brazil.

Mr. H. C. Mellor, technical director of Bayer Agriculture Ltd., presents the Bayer Agricultural Essay Trophy to Mr. A. C. Taylor of Nottingham University for his prize-winning essay on 'The Significance of Pests and Diseases in the Reduction of Crop Yields.' Mr. Taylor has obtained his B.Sc. in Agriculture and is hoping to go on to Cambridge University to continue his studies

Arabian Packaged Dates

Saudi Arabia is exporting packaged dates for the first time in the country's history, following technical advice from a Food and Agriculture Organisation expert.

Toxic Chemicals in Agriculture

The U.K. working party on precautionary measures against toxic chemicals used in agriculture, under the chairmanship of Prof. Zuckerman, has now completed the second stage of its enquiry, relating to possible risks to consumers arising from the use of these substances in agriculture and in the storage of food, and its report thereon will be shortly presented to the ministers concerned.

Prof. Zuckerman has now been asked to extend the range of his investigation to possible risks to wild life. The terms of reference of the working party for this purpose are to investigate the possible risks to the natural flora and fauna of the countryside from the use in agriculture of toxic substances, including the possible harmful effects for agriculture and fisheries, and to make recommendations.

The working party has been reconstituted for this part of the investigation, and now includes representatives of the Agricultural Departments, the Fisheries Departments, the Nature Conservancy, the Agricultural Improvement Council, the Agricultural Research Council and the Medical Research Council.

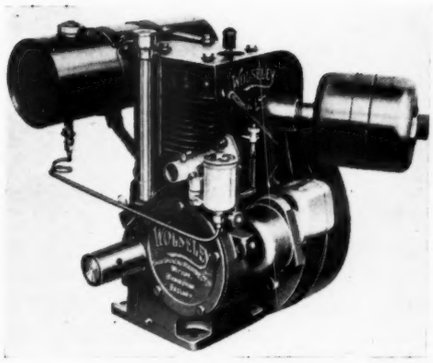
FARM MACHINERY

Trench Excavator

The new Dinkum Digger tractor-mounted trench excavator, which has been developed by Whitlock Bros. Ltd. of Essex, was recently demonstrated in Birmingham. It is stated that the new machine broke through tarmac, brick rubble, concrete and cables and made an excellent job of a trench 7 ft. deep and 2 ft. 3 in. wide. The machine was shown on the linkage of a Ferguson tractor but it is understood that other models will be available for the Fordson Major, Nuffield, etc., with various width buckets and other auxiliary equipment. The digging, slewing and loading is done by hydraulic rams controlled by two-way valves, and the oil is supplied by a single pump at 2,000 p.s.i. pressure driven from the p.t.o. of the tractor.

Hay Baler

A new McCormick International hay baler, with a capacity of up to 10 tons an hour, has been announced by the International Harvester Export Co. An automatic-tying, engine-driven, pick-up baler, the No. 55 is made in both twine-tying and wire-tying models. The machine is mounted on a heavy, one-piece, tubular steel axle carried on two pneumatic-tyred wheels. It is stated that hay receives less handling and moves in a more direct line through the No. 55 to retain maximum quality. A spring-tined cylinder picks up the windrow and transfers it directly on to the low-level cross-feed deck. The deck is level with the bale chamber so that no further elevation is required, and the hay can be fed directly into the chamber. This direct feed makes the use of an elevator, cross conveyor or feeder head unnecessary.



This is a new air-cooled engine which has been developed by the Wolseley Sheep Shearing Machine Co. for all types of farm machinery requiring motive power

Both the twine and wire-tying mechanisms are designed especially for hay balers, and the tie is made close to the bale to prevent slackness in the twine or wire. A slotted plunger head is said to permit uninterrupted plunger action during the tying cycle and to result in bales of more uniform density and increased baler capacity. The No. 55 baler turns out a new sized bale with a 15 in. depth and a 19 in. base. The company states that the low, wide shape of the bales prevents shifting in the load, and that bale tension is controlled from the top and bottom of the bale chamber, whose sides are strapped rigidly together to prevent distortion and to produce bales with straight sides and square ends. The machine will make wire-tied bales that weigh up to 125 lb. or twine-tied bales up to 80 lb. in weight. The balers may be equipped with a 15 or a 22½ h.p. International engine, depending on baling requirements.

The new International No. 55 baler is said to turn out a new sizes bale with a 15 in. depth and a 19 in. base

Power Units

A considerably expanded range of B.S.A. power units for numerous applications in agriculture and industry were shown recently for the first time. One new unit shown was the Model C 120 c.c. Power Unit which is said to be one of the lightest and most compact stationary power units for its output yet produced. The single-cylinder air-cooled four-stroke side-valve engine develops 2 b.h.p. at 3,000 r.p.m. Special features are a totally-enclosed automatically-lubricated valve mechanism with adjustable tappets; direct lubrication to big-end bearing by gear train; flywheel magneto ensuring easy starting; and an air-cooling system by flywheel fan, the air being directed by a neatly shaped cowling. The company states that this new power unit has been designed and built as a robust unit that will give lengthy and continuous service with little maintenance.

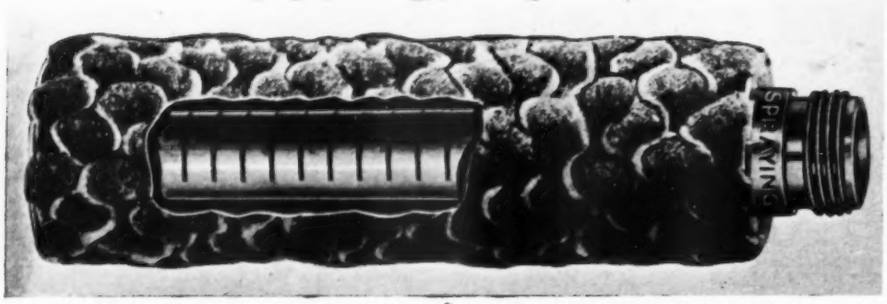
Morris Van

The Nuffield organisation has recently announced an entirely new Morris quarter-ton van, which is said to embody many features unique for a vehicle of its class. The new model, equipped with the British Motor Corp. 800 c.c. overhead valve power unit and independent front suspension with torsion bars, is said to have the performance, roadholding and comfort characteristics of the Morris Minor, on which it is based. In addition, the van body has a capacity of 78 cu. ft. with an extra 12 cu. ft. of space available beside the driver.

The van is to go into immediate production and will be available on both the home and export markets either with an all-metal van body, an all-metal pick-up body (with or without the canvas tilt) or in chassis/cab form (the cab back panel being an optional fitting).

Electrical Grain Blower

On page 300 of the July issue a machine produced by Scottish Mechanical Light Industries Ltd. was referred to as an ' electrical grain mower.' This should have read ' electrical grain blower.'



This suction filter has been developed for use with sprayers

Sprayer Filter and Strainer

The Spraying Systems Co., which manufacture farm spray nozzles and related equipment, has developed a new suction filter for use with sprayers, where the water used contains sand or silt. While sand and silt particles may not clog spray nozzles they will in time cause excessive pump wear, but using the company's new No. 5610 suction filter it is said that pumps will be fully protected and pump repair money will be saved. This filter is made of special felt washers, held by and tightly compressed around a brass core. By loosening a single holding screw, the felt washers are easily removed for cleaning. The outlet end is threaded for $\frac{3}{4}$ in. garden hose connection.

The company is also producing the No. 5470 suction strainer. It is said to provide a quality strainer at about 25% less cost than before. The complete strainer unit consists of three pieces that can be quickly disassembled by hand for easy cleaning. The design permits withdrawing liquid to a very low level and the outer brass casing protects the strainer element from damage. The outlet end connects directly to hose. The strainer is supplied in all brass or aluminium and there is a choice of strainer element sizes.

Combine Attachments

Attachments designed for fitting to the Massey-Harris 726 and 780 combines are available. They are said to be easily attached to form an integral part of the machine. Although in many cases combining techniques may vary, two accessories are available to ensure, it is said, maximum yields at all times. The Universal Pick-Up Reel deals with laid crops which it gathers ahead of the knife. It is claimed to provide increased yields from down and tangled crops by effective handling and less shattering.

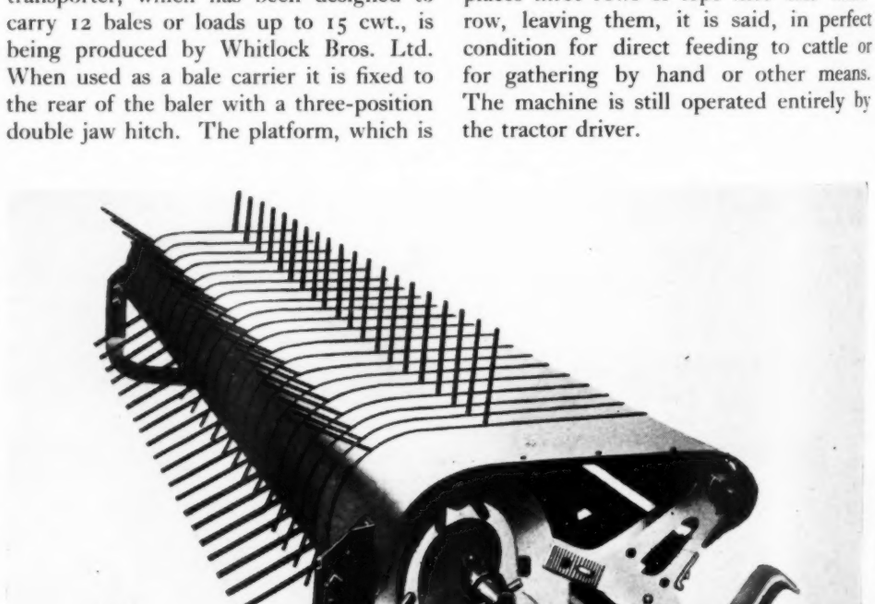
Although most crops can be combined direct, some, such as small seeds which do not ripen evenly, are usually better windrowed. The Massey-Harris Pick-Up Attachment is said to provide a speedy and effective method of handling swathed grain. The method of fitting is simple, and the attachment is an integral part of the combine table. The use of this attachment enables the farmer to extend his combine season by cutting early, swathing and then harvesting. In all fields where straw is to be ploughed in, a straw spreader should be used to prevent blockages to the plough. The Massey-Harris Straw Spreader is driven by a belt drive and distributes straw evenly over the stubble.

Bale Carrier

A new type of combined bale carrier and transporter, which has been designed to carry 12 bales or loads up to 15 cwt., is being produced by Whitlock Bros. Ltd. When used as a bale carrier it is fixed to the rear of the baler with a three-position double jaw hitch. The platform, which is of pressed steel, is composed of two panels each 5 ft. by 3 ft. which are hinged together, the rear portion being mounted on 15 by 4 cushion rubber tyres. A spring-loaded latch with a foot-operated pedal fastens the two parts of the platform together. The bales are loaded towards the rear by an operator standing on the front platform, the front of the bales being held in position by spikes fitted to the floor. When the required number of bales are stacked the operator depresses the foot pedal which tilts the back platform and disengages the spikes, enabling the stack of bales to slide to the ground. Immediately they are deposited the platform is automatically returned to the level position by the weight of the operator, the catch automatically re-engaging. A detachable guard rail and non-slip false floor are provided for the operator. With these removed the carrier makes an all-steel low-loading trailer with a floor 6 ft. by 5 ft. suitable for carting meal, fuel, straw, etc.

Beet Harvester

The new Standen Universal Harvester Mark II, with top windrower, produced by F. H. Standen and Sons Ltd., not only tops, lifts, cleans and loads the sugar beet into an accompanying vehicle but also places three rows of tops into one windrow, leaving them, it is said, in perfect condition for direct feeding to cattle or for gathering by hand or other means. The machine is still operated entirely by the tractor driver.



This pick-up attachment is said to provide a speedy and effective means of collecting swathed grain

WORLD CROP REPORTS

INDIA

Oilseed crops. In 1952-53, larger acreages were planted to all major oilseed crops in India except castor, and the outlook is for increased production of all oilseeds and their oils except peanuts. With the decline of an estimated 169,000 short tons in the production of peanuts, the principal vegetable oil crop, total production of the major oilseed crops, peanuts, sesame, castor, flaxseed and rape, and mustard is expected to be down 44,000 tons from 1951-52.

SOUTH AFRICA

Sugar. The first estimate formulated by the industry places the probable crop in the 1953-54 season at 705,300 short tons, which compares with a production in 1952-53 of 670,188 short tons. Whilst this was considered to be a conservative estimate, it was pointed out that the industry had experienced an unusually dry period during the months of March, April and May this year, which might be serious in view of the dry winter period.

It was hoped that good rains might be received before the winter had set in. If these rains materialised the crop would have been improved substantially.

This estimated increase, together with the 51,000 long tons carried over from last season, has improved the supply position to the extent that all quotas in the domestic market have now been abolished.

(*Czarnikow's 'Sugar.'*)

U.S.A.

Flaxseed. Farmers in the United States have indicated their intentions to plant approximately 4,142,000 acres to flaxseed this year. This would be an increase of about 20% above the 3,450,000 acres planted in 1952. Since an acreage of this size would produce more than 36 million bushels, the U.S. Department of Agriculture has urged farmers to reconsider their seeding plans in view of the large quantity of linseed oil already in existence. The July 1, 1953, carryover of flaxseed and linseed oil from preceding crops is expected to have been the equivalent of about 42,300,000 bushels of flaxseed. The total domestic use and exports are expected to be about the same in 1953-54 as the 30 million bushels so used in 1952-53.

World flaxseed production in 1952 is now estimated at 132.9 million bushels. This compares with 123.1 million in 1951 and 134.2 million in 1950. The relatively large supplies in other producing areas are available at values well below U.S. prices.

Winter wheat. Production of winter wheat in the United States as of May 1 was estimated at 720,350,000 bushels, compared with the government estimate of 714,154,000 bushels on April 1 and production of 1,052,801,000 in 1952. The ten year average is 797,237,000 bushels. Acreage abandonment and diversion to uses other than grain amounted to 10,278,000 acres, leaving 45,083,000 for harvest, compared to 50,348,000 in 1952 and the ten-year (1941-50) average of 45,245,000 acres.

The condition of the growing crop on May 1 was relatively low at 71% of normal, compared to 90% a year ago and the ten-year average of 84%. The condition was well below normal in all of the south-western States, while considerably above in all States east of the Mississippi River. Seeding conditions in the south-west were very unfavourable last autumn, due to dry soil conditions which resulted in long delayed emergence of the plant which in turn has made for limited plant and root development in much of the Great Plains area. Abandonment was estimated at 18.6% of the seeded acreage which compares with approximately 8% a year ago and the ten-year average of 10.1%. Heaviest losses occurred in Texas, Oklahoma, Kansas, Colorado and New Mexico. Lack of adequate subsoil moisture left the ultimate yield largely dependent upon well-timed precipitation. The production estimate was based upon expectancy of normal weather conditions prevailing until the crop was harvested.

Grain crops. The Crop Reporting Board of the United States Department of Agriculture has made the following estimates from reports and data furnished by its crop correspondents and agents:—

IRAN

Cotton crop. The 1952-53 cotton crop in Iran is estimated at 147,000 bales (of 500 lb. gross) instead of 165,000 bales as estimated earlier. This is still a record crop, slightly exceeding the 124,000 bales produced in 1951-52 and 129,000 in 1950-51. Preliminary reports place the acreage planted for the 1953-54 crop at about 500,000 acres, compared with 445,000 last year. Growing conditions have been favourable this year to the end of April.

The consumption of cotton in Iran in 1952-53 (Iranian market-year ends August 22) is estimated at 69,000 bales, the same as in the previous year. Spinning operations were begun recently in a new mill, but it is not yet working at capacity.

CHINA

Rice crop. The East China rice harvest is estimated to total 25 million tons in 1953. About 14 million hectares have been sown. East China formerly imported 1 million tons of grains from abroad but now has an exportable surplus.

PAKISTAN

Jute crop. The supplementary review of the area under jute crop for the year 1952-53 is 1,907,000 acres (*olitorius* 447,870 acres, *capsularis* 1,433,090 acres and *mesta* 25,855 acres), as against 1,779,000 acres reported in the supplementary review of the previous year, showing an increase of 7.2%. The increase in acreage is attributed to favourable weather conditions.

The total yield of the crop for the year 1952-53 is estimated to be 6,823,000 bales of 400 lb. each (*olitorius* 1,651,860 bales, *capsularis* 5,109,450 bales, and *mesta*

YIELD (per harvested acre) (bushels)

	June 1, 1953	*May* 1, 1953	*Final*, 1952	*Final*, 1951	*Average*, 1941-50
Winter wheat	17.3	16.4	20.9	16.2	17.7
Rye	12.1	10.8	11.5	12.5	12.1

PRODUCTION (million bushels)

	June 1, 1953	*May* 1, 1953	*Final*, 1952	*Final*, 1951	*Average*, 1941-50
All wheat	1,132.5	—	1,291.4	980.8	1,084.7
Winter wheat	769.9	729.9	1,052.8	646.3	800.0
All spring wheat	362.6	—	238.6	334.5	284.7
Durum	Not given	—	21.4	34.8	38.0
Other spring wheat	Not given	—	217.3	299.7	246.7
Oats	Not given	—	1,268.3	1,321.3	1,310.7
Barley	Not given	—	227.0	254.3	306.1
Rye	17.1	15.1	15.9	21.3	28.1

61,430 bales), as against 6,331,000 bales of 400 lb. each reported in the supplementary review of the previous year, registering an increase of 7.8%.

Rice crop. The fourth forecast of the area under rice crop for the year 1952-53 is 23,015,000 acres, as against 22,482,000 acres reported in the fourth forecast of the last year, showing an increase of 2.4%. The acreage reported in the final forecast of last year was 22,481,000 acres.

Except in the North-West Frontier Province, Bahawalpur and Khairpur State, where the decrease is caused by scarcity of canal water, there has been an increase in the acreage of this crop throughout Pakistan which is attributed to favourable weather conditions at the time of sowing, high prices for rice, reclamation of waste land and the campaign to grow more food. By far the largest increase in the rice acreage occurred in East Bengal.

The fourth forecast of the yield of the crop for the year 1952-53 is estimated at 8,141,000 tons of cleaned rice as against a final forecast of 7,745,000 tons in the previous year, registering an increase of 5%.

ISRAEL

Olive crop. Arab olive groves that yielded no fruit two years ago are this year expected to produce bumper harvests of 200 to 250 kg. a dunam. The average annual yield when the former Arab owners operated the groves was 50 to 60 kg. a dunam, but when the plantations were leased to private cultivators the yield dropped to from 50 to 30 kg.

Feeling that much of the 100,000 dunams of abandoned Arab plantations leased to private cultivators were going to ruin, the Government in 1951 formed a company called ' Mata'ei Ha'ooma,' in which the Finance Ministry had a 50% interest and the Agricultural and Labour Ministries 25% each.

In the past two years, the company had taken over 56,000 dunams of olive orchards, vineyards, and other fruit tree plantations. Some 30,000 dunams remained in the hands of settlements, and the rest remained leased to private operators. More than 5,000 dunams, including 3,000 dunams of vineyards, were regenerated by the company in the first year of operation, and the total harvest was 2,662 tons of fruit.

Tree nurseries were established and saplings cultivated to replace decayed trees and fill out plantations. A big project is being carried out in the sand dunes of the Migdal Ascalon area, where vineyards are being planted.

In addition to saving the plantations, the company provided work, particularly for new immigrants. Mr. Elnahem said that 1,500 persons were now employed. He complained, however, that the Government was not meeting its budgetary commitments and that suitable equipment was not being provided.

WORLD

Soya bean production. World production of soya beans in 1952 is estimated at 669 million bushels—only 1 million bushels short of the record 670 million produced in 1950. This estimate is 19 million bushels, or 3%, larger than the first forecast of the crop and exceeds the 1951 estimate of 635.5 million bushels by 33.6 million bushels, or 5%.

Over 90% of the estimated world production of soya beans is concentrated in the United States and the Chinese mainland. Roughly one-half of the total is produced in the free areas of the world, with the United States alone accounting for about 45% in recent years compared with only about 12% in pre-war years.

Soya bean production is believed to have increased in all important producing areas of the world in 1952, with possibly the most significant expansion in the Chinese mainland. There were sizable increases also, however, in the United States, and the secondary - producing countries — Japan, Indonesia, Canada, Brazil, and Thailand. Even Turkey and the Union of South Africa report record harvests in 1952. Possibly the only area of the world where output declined is Europe. The bulk of the European soya beans are grown in the Balkan area, and the severe drought in 1952 undoubtedly reduced production sharply. The estimate of output in the Soviet Union is largely speculative.

The United States harvested 291.7 million bushels of soya beans in 1952, the second largest crop on record, surpassing the 1951 outturn by over 9 million bushels and reaching 97% of the record 299.3 million bushels produced in 1950. A record acreage was harvested for beans, and over much of the country harvesting losses were less than usual. The per-acre yield of 20.7 bushels, however, was slightly less than the two previous years.

Canadian production set a new record for the ninth successive year. The crop was up 7% from 1951 and was 20 times the pre-war volume. Domestic production of soya beans, however, continues well below processors' needs and Canada imports a large volume of soya beans and soya bean oil.

Production in China is estimated at roughly 325 million bushels—200 million in China proper and 125 million in the north-east area (Manchuria). This represents an increase of 4% from the 192.9 million bushels estimated for China proper in 1951 and 12% from the poor crop of 111.2 million believed to have been harvested in Manchuria that year. These estimates would indicate, however, that production in both areas is not up to pre-war levels.

Production in Indonesia (Java and Madura) is reported at 10.3 million bushels—up over 10% from 1951 and 6% from the pre-war average. Acreage has increased gradually in the past few years.

Japan's production also was up 10% from 1951 to 19.2 million bushels despite a slight decrease in planted area. This was the highest level of production since the early 1920s.

(*Cargill Crop Bulletin.*)

Sugar production. World production of centrifugal cane and beet sugar for 1952-53 is estimated at 35.8 million short tons, raw value, a decline of 6.5% from the 38.3 million tons of 1951-52 and 1.1% from the 36.2 million tons of 1950-51. This production exceeds the average production of 1945-49 and 1935-39 by 30.6% and 25.6% respectively. The production of non-centrifugal sugar is estimated at 6.8 million short tons for 1952-53, compared with 6.5 million tons in 1951-52, an average 6.3 million tons for 1945-49 and an average 5.5 million tons for 1935-39.

World centrifugal cane sugar production for 1952-53 is estimated now at 22.7 million tons, 5.4% less than the record 24.0 million tons of last year. However, the crop is 6.1% higher than the 21.4 million tons of 1950-51, 26.1% higher than the average 18.0 million tons of 1945-49 and 35.9% higher than the average 16.7 million tons of 1935-39. The reduced production for 1952-53 reflects primarily the restricted production of Cuba and Puerto Rico. The totals for areas of the world, other than North America, show an increase of production in all cases.

Beet sugar production for 1952-53 is estimated now to total 13.2 million tons, 7.0% less than the previous year's crop of 14.2 million tons and 10.3% less than the record 14.7 million tons of 1950-51. Weather and disease damage reacted so unfavourably on the crop in Europe that increased acreage offset only in part the resulting decreases of production in most countries of that continent. Increased production is noted for the U.S.S.R., which experienced more favourable weather, and smaller increases are noted for the beet area of continental United States and for Uruguay.

COMPANY NEWS

Bah Lias Rubber Estates

The forty-second annual general meeting of The Bah Lias Rubber Estates Ltd. was held on July 3, 1953, in London.

Sir Eric Miller (the Chairman), in the course of his speech, said: The Bah Lias Company's financial position is so strong that some shareholders, I observe, are canvassing the idea that we should now distribute a large part of the resources which we have prudently accumulated over the years for the specific purpose of financing the gradual replacement of our oldest planted areas as they become uneconomic, which we would have tackled before now had not the situation in Sumatra been too unsettled. Some may even have acquired a holding in the Company with an eye to a killing. I think it therefore timely to indicate the principles which govern the actions of the Board of this Company, which was established in 1911 to take over concession lands, on which a modest amount of tobacco was being grown, with the express object of expanding the cultivation of rubber and coconuts. Some time later the tobacco venture was sold to advantage and the coconuts were gradually replaced by rubber. We made an excellent move in 1933 when we took an interest in Kulai Rubber Estate Ltd., registered in Malaya. Our stake in that company was substantially increased when we absorbed the Wampos and Bila Companies by amalgamation in 1938, for they were also shareholders—and, as our report tells you, our interest in Kulai is the equivalent of some 2,400 acres of first-class modern rubber.

People who go in for rubber growing, which is a long-term proposition, have to be tenacious by nature. Having been responsible for opening up a large acreage during the past 40 to 50 years, thus creating some of the best estates in South-East Asia, Harrisons & Crosfields are not going to throw in their hand just because conditions happen to be trying and difficult at the present time. This modern world of ours cannot get along without adequate supplies of natural rubber and South-East Asia cannot afford to see this source of wealth return to jungle conditions. All responsible people have a vital interest in preventing economic disaster in that area which is so close to Communist China. It was therefore encouraging that at the recent Study Group Meeting in Copenhagen the American Rubber Manufacturers volunteered and recorded publicly their collective understanding of the part they should play in preventing any catastrophic slump in the price of natural rubber by themselves being willing buyers at a price competitive with the synthetic product. The disastrous effect on the economy of this country if there were wholesale spoliation of the liquid resources built up by productive enterprises for the purpose of expanding or modernising their equipment to enable them to hold their own in a competitive world, should be obvious to all right-thinking people, and any such moves should be strongly deprecated and resisted in the national interest.

The report and accounts were adopted.

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